LEATHER DRESSING,

INCLUDING

DYEING, STAINING, & FINISHING.

Frontispiece.

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DYEING, STAINING, & FINISHING.

BY

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SECOND EDITION,

REVISED AND ENLARGED.

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To

The Worshipful Company of Leathersellers

of

The City of London

this Work is

respectfully Dedicated.

PREFACE

TO THE SECOND EDITION.

THE remarkable sale which *Leather Dressing* has experienced, the entire edition of one thousand copies as published, first in Parts, and afterwards, in 1907, as a bound volume, being entirely sold out towards the end of 1908, necessitates the early issue of a Second Edition.

The fact of the book being accepted as a standard work, not only in England, but also on the Continent, is a compliment keenly appreciated by the author. A French translation by Professor L. Meunier and Mons. J. Prevot, is in the press; and a German edition, the translation of the late Dr. Maschke and Dr. Jablonski, will shortly be issued by the well-known publisher, Julius Springer, of Berlin. A translation of the book into the Japanese language is also being made.

Six Chapters are now added to the work. The Chapter on "Dyestuff Comparisons, and the Testing of Dyestuffs," will be found of particular service by those who are unable to go through a course of technical study, and by leather dyers in general.

The whole of the matter of the book has been revised. For the errors that still remain the kind indulgence of the reader is requested.

The author takes this opportunity of gratefully expressing his indebtedness to the many friends who have assisted him in the preparation of the edition by suggestions for the improvement of the book and in other ways; especially his thanks are due to Mr Henry Hall, Mr. W. Farrar, and to his assistant, Mr. J. T. Jackson.

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October, 1909.

PREFACE

TO THE FIRST EDITION.

TO the comparatively small number of books that deal with the leather trades, this work on Leather Dressing is an addition, and it is the confident hope of the author that it will be of some assistance to both manufacturers, workmen, and students. It is the outcome of considerable experience, of close study of many difficulties that have been met with by manufacturers that it has been the author's privilege to investigate, and of much experimental work on a practical scale.

The book now presented is the first in which the subject of leather dyeing, staining, and finishing, is altogether discreted from that of the preparatory processes of tanning, and treated as a speciality. Very thoughtful attention has been given by the author during the past decade to the application of scientific principles to the colouring of leather, with the view of bringing a craft that was until quite recently a 'rule of thumb' industry into line with present day ideas.

As the work has appeared in parts, of which that to-day issued is the last, the author is in the somewhat unique position of writing a preface to a book now in the main already published, and moreover already commented upon by the Trade Press. The comments of both the press and of friends in the trade have been numerous and very flattering; these comments, together with the remarkable sale the work has been favoured with, have been most encouraging to the author, and have greatly stimulated him in his endeavour to make the work as perfect as possible.

To many friends, for valuable help, suggestions, and memoranda, the author has to tender his best thanks; by name he would mention the late Colonel S. B. Bevington, Mr. W. Farrar, Mr. H. Hall, Mr. T. J. Heggs, Mr. H. W. Ley, Mr. J. D. Rennie, and his assistants, Mr. J. W. Lamb, Mr. J. T. Jackson, and Mr. R. Thompson.

For the loan of Electrotype blocks the author is indebted to many Engineering friends; Messrs. Farrar & Young, Messrs. Thos. Haley & Co., Messrs. Joseph Hall & Co., Messrs. Huxham & Browns, Messrs. The Moenus Machine Co., Messrs. The Turner Turning Machinery Co., Messrs. B. & D. Wright, and others.

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INTRODUCTION.

The art of leather-dyeing and of the application of dyes to leather is of very great antiquity, dating back to pre-historic periods. Leather was known in the time of Moses; amongst the things to be used as offerings Moses mentions (Exodus xxxv, 7, 23), rams' skins dyed red; and a covering for the tent of the tabernacle (Exodus xxxvi, 19), was made of the same material. Leather carpets were then already used in tents. In the history of writing, leather plays a very important part, (see Hastings' *Dictionary of the Bible*, article "Writing"); and in the article "Colours" in same Dictionary, there is mention of red-dyed leather being made in Egypt 3,000 years B.C. Of very old red-morocco leathers many examples are still in existence.

Embossed goat-morocco straps have been found on a mummy of the ninth century B.C. Specimens of leather made up into shoes and sandals, and dyed red and yellow, and also specimens of leather dyed a maroon colour, are to be seen in the Egyptian collection at the British Museum.

Red shoes were worn by the Romans, and it is recorded as being a singular habit on the part of Julius Cæsar, that he wore red shoes on ordinary days.

Perhaps the first work which deals fully with the subject of leather-dyeing, is a small volume "collected [by Charles Vallancey] and published in Dublin at the expense of the Dublin Society," (now the Royal Dublin Society), in 1773; the work was reprinted and re-published in London in 1774. The main features of morocco leather and the method of dyeing a red-coloured leather are described in great detail. The skins were tanned with either a species of sumach, lentiscus, or gallnuts, and the preparation for dyeing, as carried out "in the island of Cyprus," was as follows:—

"When the skins have been washed and wrung, they are prepared for the dye, the first operation of which is to alum them. Take twelve pounds of Roman alum for every eight dozen of skins, which dissolve in two buckets of hot water, containing fifteen quarts each.

"The morocco dressers prefer Roman alum to all other kinds; it is of a reddish colour, and brittle. English alum blackens the skins, and is not so good in any respect.

"The skins are folded, flesh against flesh, that the grain alone may be alumed, and thus dipped in a pail of alum lukewarm; it is stirred in it for the space of half-a-minute, taken out, and put on a beam four feet high, placed in the work-house for that purpose.

"The alum water drained out, they are wrung with a wooden wringer; (iron is not to be used), and hung on a wooden beam placed in a corner of the work-house to drain, placing an alum bucket under them to save the water that drops from them; they are wrung two at a time; after which they are sleeked on the beam to take out the folds, and folded flesh to flesh.

"The bucket in which the skins are alumed is somewhat shorter and broader, than that in which they are coloured, and which I shall describe hereafter. It requires one hour and a half to alum eight dozen of skins.

"The alum water is preserved, and serves again by dding alum and water to repair what it has lost; and at the econd mixture it requires not more than nine or ten pounds of lum.

"For forty skins, they take twenty-five ounces of the nest Kermès that can be procured. It costs at Paris from fou vres to one hundred and ten sols French the pound, containing ixteen ounces; when dried it is powdered, then boiled in eight uarts of water, and when it has taken one boil, a fifth of a pound f alum is flung into it, divided into five or six parts, and kept oiling half a quarter of an hour, in which time all the alum is ast in; then the liquor is suffered to boil till it has diminished our or five fingers, and the dye is made. The more alum is dded the deeper the dye, on the contrary the more lively it wil e in proportion to the lesser quantity of that salt.

"The colour being thus made, about a pint and a hal s poured into a vessel, whilst luke-warm, into which a wisp o cotton is dipped, and rubbed on the grain side of the skins vhen the dye is laid on they are wrung in the same manner a a wet cloth would be to squeeze the water out. When th orty skins are thus dyed and wrung, they begin again with th irst, which is a second time dyed with the cotton soaked in th colour, and again wrung as at first; all these skins are thus dyed and wrung five times.

"This done, fifteen pounds and a half of gall-nuts finel powdered are added to ten quarts of cold water, the forty skin are soaked in this liquor one after another; when taken out of th gall-nut, they are washed ten or twelve times in very clean water and carelessly flung one over the other, trod with the feet and worked with the hands to get the water out; when the wate s well expressed, they are brought into dry lofts, where they ar extended on the floor.

These skins thus extended, the hand is dipped in oi of sesame (a kind of corn) with which each skin is rubbed on th

grain side; this gives it lustre and softness, and prevents its crisping; they are afterwards dried in the shade or in the sun. Such is the process at Nicosia for colouring red morocco."

Reds, the volume informs us, were dyed upon skins that had previously been prepared with honey, bran and salt, using two drachms of alum, two drachms pomegranate bark, ¾ oz. of turmeric, ¾ oz. of cochineal, 2 oz. loaf sugar, 25 oz. of sumach, with 8 gallons water; the skins being tanned after dyeing, with gall-nuts.

It seems logical to assume that at the time of these writings, little was known in Europe of the art of dyeing scarlets with cochineal and tin salts, a method which was very much practised at a later period; nor of the production of yellow with fustic and alum.

Moroccos appear however to have been dressed in Paris about this period, and dyed red with cochineal and alum. Considerable detail is given in the book regarding the method of work as carried out in Paris factories upon the goods after dyeing. Part of this follows: eight dozen skins are being dealt with.

"When washed, two men hand-wring them by pairs; they are shook and extended lengthways on a table, to receive the sesame oil one after another, the flesh side being on the table, and the grain upwards.

"The oil is contained in a wooden bowl; a sponge about the bigness of an egg, or a swab of wool, is dipped in the oil, and passed on the grain to soften them, and to prevent the air from crimping and hardening them, they are hanged on hooks by the pattes [paws], the head downwards, grain to grain at a small distance from each other, and are so disposed, that the current of air may strike side-ways in the intervals, for if it struck the surface of the grain, it would destroy the colour. About two pounds of oil are required for the eight dozen of skins, and two men half a day to shake, oil, and hang them up.

"These moroccos remain one or two days (more or less, according to the weather), in the drying loft; sometimes they are taken down the same day: in winter they often require a week: however they are taken down as speedily as possible.

"Being thoroughly dry, they must be curried and glazed being first folded two by two in small wisps, grain to grain, and trod on a clean floor, two at a time, with curriers' shoes, made for that purpose. One man may tread four or five dozen in a day. Then they are to be grained with a wooden graining board, lengthways, breadthways, also cornerways, or from corner to corner. A man will grain four dozen a day.

"They must be perched on the flesh side with the perching-knife, rubbing it with whiting, to prevent the knife from entering too far into the substance of the skin.

"Red morocco is glazed with a wooden roller, held by both hands: and the skin extended on an oak-beam, on which there is a piece of pear-tree wood, projecting a quarter or an eighth of an inch: a weight with a small hook is suspended on the side of the skin, which pulls it down, whilst the glazier holds and governs it with his thigh, letting it slide as necessary, in proportion as he advances in his glazing.

"Each skin is twice glazed, that all intervals and furrows may be effaced by the return of the sleeker; this also makes the grain more shining; one man can glaze two dozen a day, for which he is paid twenty-four sols a dozen: this operation is delicate, and requires habit and skill to glaze equally and uniformly. The grain is lightly watered with a sponge to make the glazer slip easy, but this is not necessary the second time.

"Glazing lays down the grain of the morocco, but as the grain is a beauty in morocco, they rise it again by means of a cork paumelle, [piece of cork held in the palm of the hand], which is lightly drawn over, without taking off the lustre, and this is the last working of red morocco at Paris."

A further method, used by the Laplanders, to dye leather red, is described in this old and curious work; it is as follows:—

"The Laplanders to redden their skins, wet them with their spittle, after which they chew tormentil root, and rub the skins with the dregs, which gives a tolerable good red; it is probably owing to the urinous salt of the spittle, which lustres the edge of this root. This volatile urinous salt, common to all animal liquors, produces the same effect on the orchil, which is a kind of moss the dyers use with lime and urine."

The dyeing of yellow moroccos was with Persian berries and alum; of blue with turnsole [archil] and indigo; green with verdigris and tarbar.

Blacks were obtained by brushing over with a black of sour beer in which old iron had been infused, the skin being polished by lustring the grain with barberry juice, garlick, citron, orange or sour beer.

The book issued by the Dublin Society also gives "processes for dyeing leather red and yellow as practised in Turkey, as communicated by Mr. Phillips, a native of Armenia, who received from the Society for the Encouragement of Arts, &c., one hundred pounds, and also the gold medal of the Society, as a reward for discovering this secret."

The advances made in the dressing of leather during the past 50 years have been considerable, and many new processes have been introduced. In bringing these into existence science has played no mean part.

Most of the old-fashioned dyestuffs have, for ordinary leather dyeing, been entirely abandoned, the more easily applied coal-tar dyestuffs being substituted. The dyeing process has been thus considerably simplified and shortened, and the change of procedure has been conducive to the obtainment of a more level dyed result.

For the production of blacks on leather, the natural dyestuff, logwood, has not yet been entirely supplanted by a coal-tar product; the substitution will come however, it is only a question of time. The advantages of the natural dyestuff are cheapness, regularity of shade, and the filling and plumping property of the dyestuff. The last-named property is a particular advantage in the case of chrome-leather.

Machinery has found ways of applying colouring matters to leather. The paddle-wheel and drum methods of dyeing facilitate the turning-out of large packs of dyed leather in a short time and with very little labour. The older methods however have not been entirely discarded, and the method of dyeing by tray is still practised in some manufactories in manner exactly similar to that in which it was carried on a hundred years ago.

Machinery has also found out how to perform many of the operations that were formerly hand operations entirely; for example, shaving, striking-out, buffing, glassing, &c. But, as with the dyeing, the hand-methods for these operations have not been entirely dismissed.

The leather-dyer of to-day has to deal with leathers unknown 50 years ago. Of the innovations of the present century the United States' Patents of Schultz (1884), and Martin Dennis (1893), for chrome-tanning, are the most startling and practical; these inventions have attained to very considerable commercial importance.

Leathers tanned with aldehyde (British Patents of Payne & Pullman) are also commercially important. Combination-tanned leathers, leathers tanned with mixtures of vegetable and mineral tanning-materials, are introductions of late years. One of the latest of the combination-leathers, semi-chrome leather, a vegetable-tanned leather re-tanned with basic chrome-salts, has become very popular.

The treatment of leathers with oil emulsions, fat-liquoring as it is termed, originally invented by an American named Kent, for use on combination-alum leather, is now common practice upon all kinds of leather.

The introduction of drum-stuffing and the more recent process of dipping, have completely changed the latter-day methods of the currier.

New leather-dressing and leather-dyeing processes are coming to the front continually, and new leather machinery being brought out, and the changes of procedure that have taken place during the past decade have been numerous. The work of leather-dressing as carried out at the present time is so different from what it was as carried through by our forefathers that it may be said to have been completely revolutionised. The keen competition in the leather trade paves the way for both the scientist and the inventor, and the discoveries of the former of these and the contrivances of the latter will no doubt continue to play their part in the introduction of methods of dressing leather more perfect than the now existing methods, to the benefit always both of the leather industry and of mankind in general.

LEATHER DRESSING,

INCLUDING

DYEING, STAINING, AND FINISHING.

CHAPTER I.

GENERAL PRELIMINARY OPERATIONS.

§1. To dress leather is to prepare it for its various uses. As regards the skins of the smaller animals, the tannage of them is part of their 'dressing.' With the skins of the larger animals, the tanning and dressing are distinct procedures. The skins of the larger animals are commonly termed 'hides,' but the words 'skin' and 'hide' are somewhat loosely used. The present volume does not treat at all of tanning, but, as regards both the smaller skins (light leathers), and the larger skins (heavy leathers), deals with them from the moment they leave the tanner's hands, that is, from when they become 'leather.' As leather 'dressing' includes its dyeing, staining, and finishing, there was no absolute need to have mentioned these operations in the title. The operations are there referred to, however, in order that there may be no doubt as to the ground covered by the book.

§2. SORTING.—The dried condition of skins as delivered from the tanner, is known as their 'crust' condition. Skins (colloquially spoken of as 'goods') so delivered must first of all be 'sorted,' that is to say, parcelled out according to the purposes for which they are to be used, the colours in which they are to be dyed, and to other several conditions.

§3. The crust-sorter in a leather manufactory occupies one of the most responsible positions in it. If he is not competent he may lay goods out for colours and finishes in no way suited to them; and this means the putting into the market a second rate article, as well as a loss to the manufacturing firm.

§4. For a sorter to carry out his duties efficiently he must not only be thoroughly experienced in his special work, but further, must possess a sound knowledge of leather dressing processes, be a good judge of tannages, and of the various defects that may have arisen during the operations of tanning before the skins come into his hands. Skilled as to defects, he recognises at once the most common kinds of stain met with in crust stock, and knows how these behave in the preparation for dyeing, and in the dyeing, and will not reject skins as unsuitable for good quality stock, the stains in which may be entirely removed in preparing for dyeing, or unnoticeable after dyeing.

§5. As regards methods of sorting, it may be said that each particular sorter has his own favourite method and his own views. Manifestly, when only a limited number of skins have to be dealt with, very close sorting is to no purpose, as it is not commercially possible to prepare a special solution and dye each few skins. When, on the contrary, the number of skins to be sorted is large, then the sorting can be carried closely down according to the final leathers that the various goods will produce. With a large quantity of skins the smallest of the assortments is almost sure to be large enough to warrant a treatment special to itself.

§6. Skins in the crust should be sorted in a well lighted room, and the sorter should preferably have his table opposite a window. He should examine tannage, quality, defective grain, and stains; and among other points he should look to are, size and substance,

texture, whether the goods are 'short of leather' (undertanned), for what several colours, if to be dyed, they are suitable, and for what particular finishes they are best adapted. Grading the skins into packs or piles, as many as may be necessary, the sorter selects those skins which are free from stains and other imperfections for pale or bright colours or shades of colour, such as scarlets, light olives, blues, etc.; goods that are stained are parcelled out by him for dark colours, such as sage and olive greens, blues, maroons, etc., where the defects will not be apparent when the goods are dyed; and when so badly stained that they cannot be dressed in colours they are parcelled out to be utilised for blacks.

§7. The character of the outside surface of a skin is its 'grain,' and there is a distinctive grain to the skins of animals in all their varieties. As stated in §2 above, skins leave the tanner's hands in 'crust' condition. What is said in that section as to skins applies to 'skivers' also. A 'skiver' is the grain half of a sheepskin which has been 'split' before the tanning (§42). In sorting skins and skivers many of the difficulties incidental to successful leather dressing may be lessened or avoided by paying attention as far as circumstances permit, to the following hints:—

Sorting of Sumach-Tanned Leathers.

§8. Skivers.—A 'skiver' being an exceedingly thin leather is stiffened in the finishing, when intended for finishing as a 'paste-grain,' by covering the flesh side with a solution of glue applied in the form of a stiff jelly. The skiver being too thin to keep the grain natural to the skin, has a grain given to it artificially. When the simulated grain runs one way in irregular streaks, the term given to the skivers is 'long-grain' or 'straight-grain.' The external integument of a skiver often exhibits a tendency to roll up upon the under layer; for the outer integument to thus roll up is for the skiver to 'pipe.' In sorting skivers, goods intended for paste grains should be selected from those which show little tendency to pipe. Skivers which are inclined to pipe should be sorted for dressing into plain finish; no grain at all that is. An intermediate

selection is suitable for the straight-grain finishing; the grain being printed by means of a roller, an operation which in part counteracts the tendency to pipe. In sorting these goods attention should also be paid to the flesh side; many skivers are unsuitable for particular finishes because of their having been badly split. Stout skivers may be parcelled for hat leathers, and for other purposes which call for a good substance.

§9. SUMACH GOATS.—The first selection with these should be for substance; stout large skins being favoured for upholstery leathers and goods of medium size for bookbinding purposes, fancy pocket-books, and other such articles. After sorting for substance, they may be selected according to grain; those possessing bold grain being selected for hard grains; those of loose grain with inclination to pipe being selected for a printed finish.

§10. ROANS.—A 'roan' is a sumach-tanned sheep-skin. After selection by size for particular purposes, skins disposed to pipe should preferably be set aside with a view to their utilisation for goods that are to be embossed.

§11. CALF.—Sumach-tanned calf is usually finished plain for bookbinding or fancy purposes. The skins having been sorted according to size and quality, are graded according to their suitability for being dyed in particular colours.

§12. SORTING OF OTHER VEGETABLE TANNAGES.—In the sorting of these tannages, classification by tannage as well as by purpose is specially important; in other respects the sorting should be carried out in much the same way as above explained for sumach tannage. The reason for the sorting by tannage is that it is never advisable to dye two different tannages in the same pack (a pack intended for shoe-calf suppose), seeing that they behave differently in the dyeing and do not come out of the same colour.

§13. The manner in which one particular tannage will dye as compared with another is somewhat remarkable. Goods which have been tanned with Valonia, Myrobalans, &c.—tanning

materials or 'tannins' of the Pyrogallol series—are by no means so easily dyed or stained as goods which have been tanned with Catechol tannins, Quebracho, Gambier, Mimosa Bark (Australian tannage), Turwar Bark (the main tannage practised in India), Mangrove, etc.

§14. A notable exception to the above rule is Sumach, a Pyrogallol tannin which, as is well known, produces a leather that dyes and stains very readily.

§15. After the general sorting of the goods as above described, attention should be paid, so far as is possible, to the final selection of goods according to texture. Skins having a close, fine, smooth, grain should not be dyed with those of which the grain is open or coarse; and soft and mellow skins are best separated from those possessed of a hard and harsh feel. The colour of goods arranged in the same group should be as uniform as is practicable. Goods of open and coarse grain naturally absorb more dyestuff, the resulting shade thus being much deeper than with goods of a close, fine grain, which do not absorb the dyestuff so readily. Skins even of the same class exhibit in a greater or less degree this difference in grain; and it is a well-known fact, in the case of a pack of skins which have been dyed in the same bath, that there are always one or two which do not come out exactly the same shade as the rest because of difference of grain and slight diversity in the colour of the leather. The very object of the sorting is that there may be no such eventualities.

SOAKING FOR SPLITTING, SHAVING, AND DYEING.

§16. SOAKING FOR DYEING.—The first operation on goods which are to be shaved after dyeing, as for instance sumach goats for upholstery purposes, is the soaking. The object of soaking is to get the goods into a thoroughly wet condition that will allow of their being well struck out, also to remove surplus tanning matter, etc.

§17. The operation is best carried out by steeping the skins until thoroughly wet in a large tub of water at a temperature of 40°C (104°F). When this has been done the skins are preferably

transferred to a drum, and drummed for half-an-hour with a sufficiency of water at 40°C. This water should then be run off, fresh water supplied at same temperature, and the drum revolved for a further period of ten minutes.

§18. A drum with hot water laid on so that it can be run through the hollow axle of the drum whilst revolving is to be recommended where saving of labour is a consideration. And if the drum is fitted with plugs easily removable, so as to allow the waste water to run off without stoppage of the drumming, the goods can be thoroughly soaked with but little labour. The previous soaking in tubs can be omitted if desired, the dry goods placed in the drum direct, and the hot water added before the drum is started.

§19. Soaking for Splitting and Shaving.—Calf skins, light kips, etc., which are to be shaved or split previous to dyeing are usually simply dipped in tepid water, and then laid in pile or horsed up for some little time, in order to get them into a suitable damp ('sammed') condition. The dipping of the skins is generally one by one in a large tub, and the immersion for one or two seconds only. The thickest portions of the skin are usually dipped twice. For example, in an East India kip the neck end is dipped a second time, the kip, which is double down the ridge as removed from the bale, being plunged cornerways in the soaking tub so as to give an extra wetness to the hump, the doubled kip being then turned round and the tail end dipped in order to well damp the harder portion of the butt. The soaking is considerably facilitated by using water heated to a temperature of 35-40°C. (95-104°F.)

§20. In soaking calf skins of a good quality tannage, the goods are either simply drawn through water, preferably one at a time, or the soaking is done in the drum, an addition of a little warm water (45°C. or 113°F.) being made through the hollow axle of the vessel whilst the drumming progresses, not more than sufficient to damp the leather right through.

§21. Hides, calf skins, etc., that are to be hand-shaved are best prepared for the operation by being treated exactly as above

described for splitting; the goods after soaking being left in pile for some hours in order to get them into a thoroughly and equally damp condition.

§22. It is the custom in many works to thoroughly wet the leather either by prolonged soaking, or by drumming with a larger quantity of water than is necessary to superficially wet it, and afterwards to horse it up to drain for some three or four days, the goods being then hung up to sam. This method by the way has nothing to recommend it in the majority of cases from the point of view of economy, and if it is adopted, due precaution should be taken that the goods, when piled, do not heat up, or mildew, which they are very liable to do, especially in warm summer weather; another disadvantage is that goods left in pile for a long time sweat and become sticky. Twelve to twenty-four hours in pile is usually ample with most tannages.

§23. The addition of a small quantity of carbolic or formic acid to the water used in soaking will tend to prevent mildew; and the goods should be occasionally turned over to prevent heating with its attendant discolouration, and its damage to the leather fibre if allowed to go too far.

§24. Foreign tanned kips which have much extraneous matter, plaster, etc., adhering to the flesh side, are best drummed for a short time after soaking; the drumming, in addition to removing much of the foreign matter, helping to soften the goods.

§25. In the case of East Indian sheep and goats, Australian basils, and light skins generally that are to be machine-shaved, the better method is to place them in the drum, and whilst the vessel is revolving, to run in through the hollow axle sufficient water to damp them, and then to continue the drumming for a short time so as to equalise the moisture as much as possible and thoroughly soften the goods, horsing the goods up over night after that in order to complete the 'sammying.'

§26. Goods to be split should be free from folds and creases. Many manufacturers put the skins through a process that has been termed 'jacking.' This 'jacking' is done on a machine

very similar in construction to the inclined-bed glassing machine (see §801, Chapter XVII), but possessing a 'stone' tool instead of one of glass or agate. This 'jacking' is an undoubted advantage when really good splitting is required on best goods.

§27. In working light goods, calf, sheep, and goat, which are to be shaved or split, then instead of jacking the goods they may be passed once through a striking-out machine (Chapter XI). This adds perhaps a little to the labour, but in the long run it is undoubtedly a saving, as when the skins are well opened out by the operation, the shanks and other loose portions of the skin are not so liable to be torn off or cut away in the subsequent operations.

The operations which follow the soaking and softening depend entirely on the class of goods under treatment, the purpose for which the leather is intended, the shade the skins are to be dyed, etc. After soaking, the goods are ready for the reduction of their substance to that required, by either splitting or shaving.

LEATHER SPLITTING.

§28. To split is to sunder violently, and the course that a split takes is determined, as for instance with many of the varieties of wood, with mica, etc., by the nature of the material. If the material does not by its nature assist division, then to speak of splitting the material is a misuse of the word. And it is a misuse of the word in the case of leather, where splitting means slicing, that is, dividing the leather in its thickness. The nature of the material here in no way assists division of it or gives direction to slicing; the material, indeed, cannot for one instant be left to itself, but must be persistently held up to the cutting knife. The slicing or 'splitting,' as usage sanctions the term, is effected by machine, and the machines in the market for leather splitting are the 'Union,' and the reciprocating knife and band knife machines.

§29. If a piece of leather is pulled or thrust in the direction of its thickness against a knife edge, it will bend and escape the knife as soon as it is easier for it to do this than to stand to the cut. In all machines for leather splitting the leather is urged forward

against a knife, and hence in them all, provision has to be made against the flexibility of the leather. The provision is made by appliances which take a firm grip of the leather, the closest that can be to the knife edge, and which maintain the grip as, by the advance of the leather, the splitting proceeds. It is evident that the closer the grip on the leather is to the knife, that is to say, the less leather there is between the knife and the grip, the more impossible it is for any bending of the leather to take place.

'Union' Splitting Machine.

§30. A representation of this machine, in actual working, is seen

Fig. 1.

Fig. 1. Splitting on Union Machine.

in Fig. 1. A section of a Union machine is shown in Fig. 3. Of whatever make a Union machine may be (Figs. 1 and 2 are of machines of different makes), the essentials are the same, though details differ. The knife of the machine, F in the sectional view, is stationary, and is firmly held down on its seat by bolts, one of

which, G, with ring-nut, is seen in the section. The knife has slots where the bolts pass through, so that it may be shifted forward on its seat as it becomes narrower by grinding. The beam B carries the nipping or gauge roller D and its supporting rollers C; it can be turned right over by the assistant out of the operator's way by the handle E. In Fig. 1, it is upon the beam that the operator has placed his right hand. Spring plates on which the leather rests are seen at H. N is the draw roller, with grooves in it from end to end; A is one of the set-screws

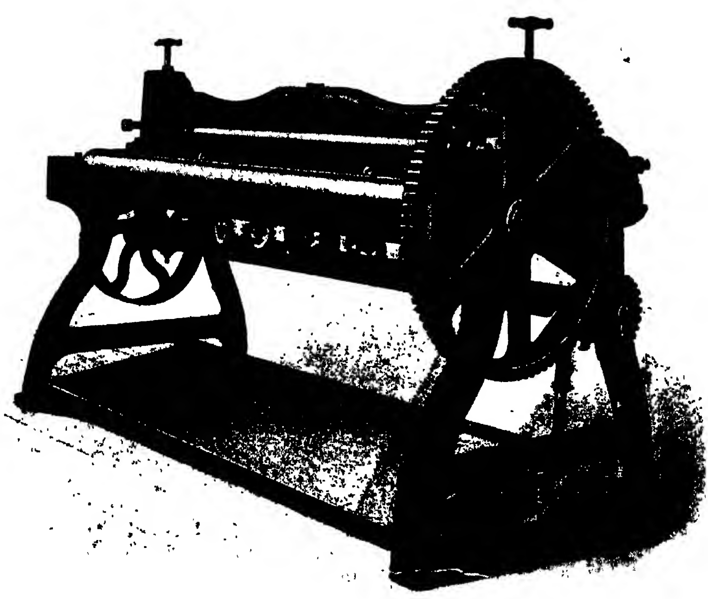

Fig. 2.—Union Machine.

of the beam. The set-screw A is here fitted with a hand-wheel; in Fig. 2 the set-screws have T heads. The operator in Fig. 1 view grasps one of these with his left hand. Further references are unnecessary.

Fig. 3.

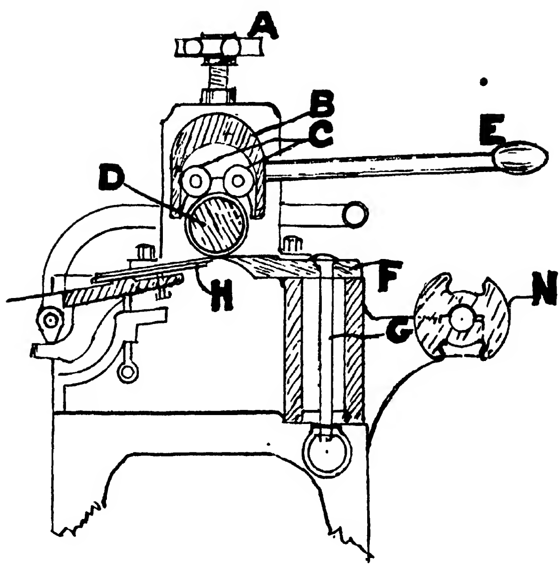

Fig. 3.—Section of Union Splitting Machine.

A Set Screws.
B Beam, carrying Gauge Roller **D.**
C Supporting Rollers.
D Gauge Roller.
E Handle.
F Knife.
G Holding-down Bolt.
H Spring Plates.
N Draw Roller.

§31. The working of the machine is as follows:—The bea being turned out of the way by the handle E, one end of t leather to be split, grain side upwards, is passed over the plat H and the knife F, and brought into one of the grooves the draw roller N, where it is firmly secured with a piece wood. The bringing back of the beam into position grips t leather between the plates H and the nipping roller D, and the

determine the substance of the finished leather. The large cog-wheel (Figs. 1 & 2) is on the axis of the draw-roller N, the smaller is on the driving shaft. By a foot board or treadle, seen in Figs. 1 & 2, the driving cog-wheel is thrown into gear with the larger wheel, and the leather, winding-up on the roller N, is drawn against the edge of the knife and is split, the roller D revolving as the leather passes under it.

§32. The cut is of course on the under surface of the leather, and as a considerable portion of the leather has been passed through the machine to reach the draw roller, it is evident that the cut begins some little distance from the end of the leather; usually about two-thirds of the leather being split at the first operation. To split the other portion, the leather is taken out and reversed, and the end that has been split secured in the draw roller.

§33. In splitting a number of pieces of leather, the operator sorts them, and goes through one portion of each piece first, before he reverses for the other portion, it being usual when splitting sides, to first split the butt ends, and after reversing, to split the neck ends. Working thus, his attention to adjustment is required less frequently. The assistant watches the leather as it draws through and straightens it out if it shows a disposition to crease or pucker.

§34. The parts of the machine concerned with adjustment are the plates H, the roller D, and the set-screws A. The front edge of the top plate is set a trifle higher than the cutting edge of the knife. By screwing down the set-screws the pressure of the roller D on the spring plates H is increased, and the front edge of the top plate is lowered with respect to the knife edge, and a thicker slice or shaving is taken off.

§35. To sharpen the knife it has to be taken out and ground apart from the machine. A good edge must be kept upon the knife; the better the edge the better the work turned out. And with a good edge the strain is lessened as

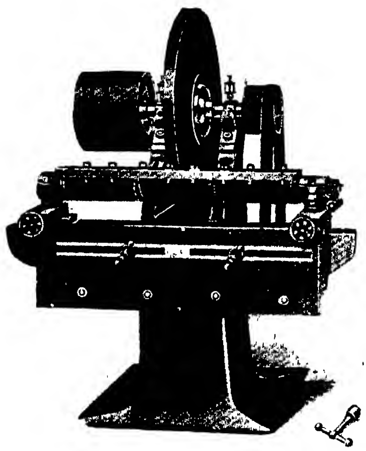

Fig. 4.—Knife-Grinding Machine.

the leather passes througl the machine. A representation of a knife-grinding machine is given i1 Fig. 4. The knife afte grinding is laid on wooden support and th edge is then 'cleared by rubbing with a 'clearing stone' in order t remove the wire formed during the grinding and obtain a smooth keel edge. It is not necessary to always grind the knife to restore its cutting edge a rubbing with the stone being sufficient, after an occasiona grinding.

§36. To speak of splitting a piece of leather certainly implies a division into two of its whole surface, and the obtaining two usable pieces of leather, each equal in area to the original piece Manifestly, however, as the cutting in the Union machine begins somewhere in the middle of the leather, no whole splits are obtainable; there being two flesh part-splits obtained from each piece of leather put through. The butt splits are naturally fairly large and can be economically utilised, and the smaller neck splits find a ready market, after dressing, for use in common purposes, as for example, linings and insoleing for boots.

§37. The action of the knife in the Union machine is that of a keen-edged wedge. Of cutting properly so called, that is, of movement of the knife in the direction of its edge, there is none. The machine is crude and embryonic, but is still much in favour amongst dressers of heavy goods such as army butts, etc., chiefly because it is possible to obtain a better finish on the split side of the leather than is obtained when the band knife machine

has been used. From this machine to a splitting machine with a moving knife is a distinct step forwards.

§38. Reciprocating-Knife Splitting Machine.—A knife may be looked upon as a saw with microscopically small teeth. A piece of wood that is to be sawn must be held as a whole for the sawing, but requires no special support close to the cutting itself. The need for support close to the cut in the case of leather, because of its suppleness, has been referred to. In the sawing of a piece of wood the saw follows up the cut it makes; in leather-splitting the knife does not follow up its cut in the material, but the material is brought up and kept up to the knife, and must be firmly supported close to the cut.

§39. The idea of such splitting is by no means recent. A patent was obtained for a leather-splitting machine upwards of one hundred and forty years ago. The reciprocation was obtained by means of a crank, and a connecting rod to the knife This portion of the machine had its own framework, and stood cross-wise to the framing of the long table that received the skins, the plan of the machine being thus  The knife moved in 'sockets' in the central uprights of the table framework, and the machine seemingly required four men to work it. In 1806, and that is more than one hundred years ago, a reciprocating-knife machine was patented by W. Parr, R. Bevington, and S. Bevington. The illustration given of it is hideous, and the description of it is of the uncommunicative order. The skins were passed between two rollers, and just where an edge of leather firmly held by the rollers presents all along between them, the knife takes its cut. As well as to bite the leather, the rollers, turning in opposite directions were used to push it forwards and kept it up to the knife. The upper roller of the two is a section roller, (like to the under-roller E, in the band-knife manchine; *see* p. 24, §56), made up of a great number of circular plates. In 1810 one 'Revere,' (known as 'Reader'?) patented a splitting-machine, which he transferred to one 'Dyer,' patentee already of a hide-splitting machine. For the under roller Dyer substituted a bar or bed. The Knife did not reciprocate however.

§40. With a reciprocating knife very little to-and-fro motion need be given to it. Whatever motion it has adds to the width of the machine, and it is not desirable to unduly increase the dimensions of a machine. In a machine put much later into the market, the skin is attached by hooks to a roller, and is drawn, between the roller and a fixed bar, against the reciprocating knife-edge. For giving a rapid reciprocating motion, Mr. J. Meredith and Sir John Turney, took out a patent in 1901. The machine has a cylinder and piston, the working agency is compressed air, and the knife receives its motion direct from the piston.

§41. The superiority of a reciprocating-knife to a stationary-knife machine is obvious. If a stationary knife accidentally gets a small notch in it, say only one-eighth of an inch wide, then, as the leather is drawn forwards, there is for one-eighth on an inch of its width all along it, a rasping or worrying of the leather instead of a cut; such a damaging of the leather indeed, as might even necessitate a there and then regrinding of the knife. The like notch in a reciprocating knife would simply be so many of the fine teeth of the 'saw' broken out, the adjoining teeth would do the work of those wanting, and there would be no damage to the leather, no mark in the splits to indicate that any defect in the knife existed.

§42. The reciprocating-knife machine is very generally used for splitting skins in their limed condition before tanning, and is in universal use for sheep skins, to separate the grain surfaces ('skivers') from the flesh surfaces ('fleshes' or 'linings'). At the end of a stroke of the knife and before it takes its return stroke, the leather that is being split is moved automatically just the depth of the knife-cut forward. The successive cuts of the knife can generally be readily seen on the back of a skiver.

§43. From the splitting machine with a reciprocating knife it is easy to pass to the splitting machine with a knife that is continuous, to, that is to say, that perfection of leather-splitting machinery, the band-knife leather-splitting machine.

BAND-KNIFE SPLITTING MACHINE.

§44. Of this machine, the illustration Fig. 13 (see page 23), is a view showing the front of the machine; Fig. 5 is a view of

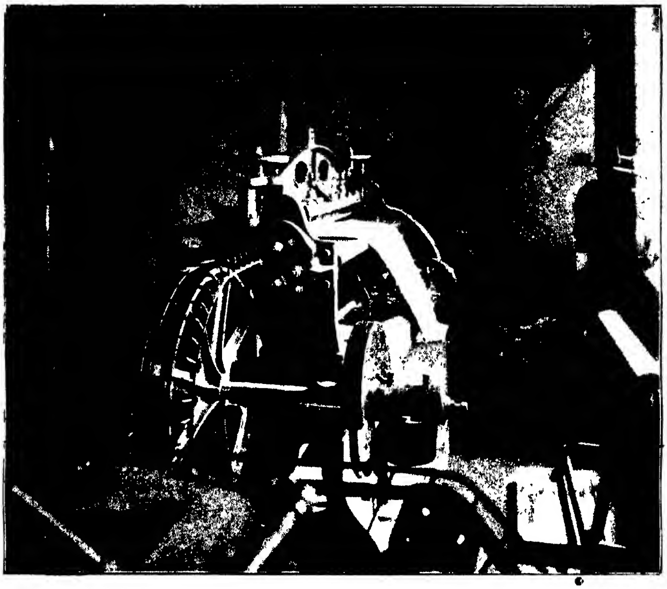

Fig. 5.—Band Knife Splitting Machine, (End View.)

another make of the like machine showing the extreme left-hand end of it, and also showing the front. Fig. 6 is a plan view

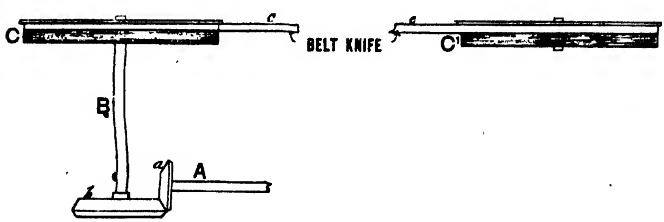

Fig. 6.—Band Knife Splitting Machine, (Plan View).

showing the disposition of various parts of the machine, and Fig. 7 a front-elevation view also showing the disposition of various parts.

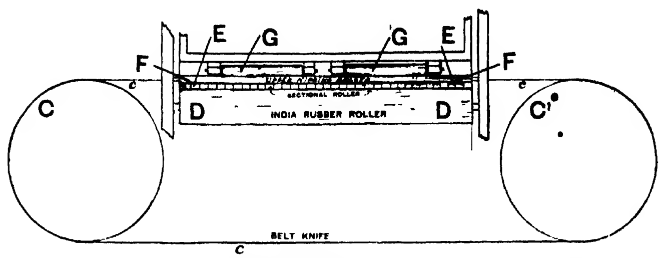

Fig. 7.—Band Knife Splitting Machine, (Front-Elevation View).

Fig. 8 is a diagram sectional-view of the several rollers of the machine and of the section-roller plates. The same letters in the several Figs. refer to the same parts.

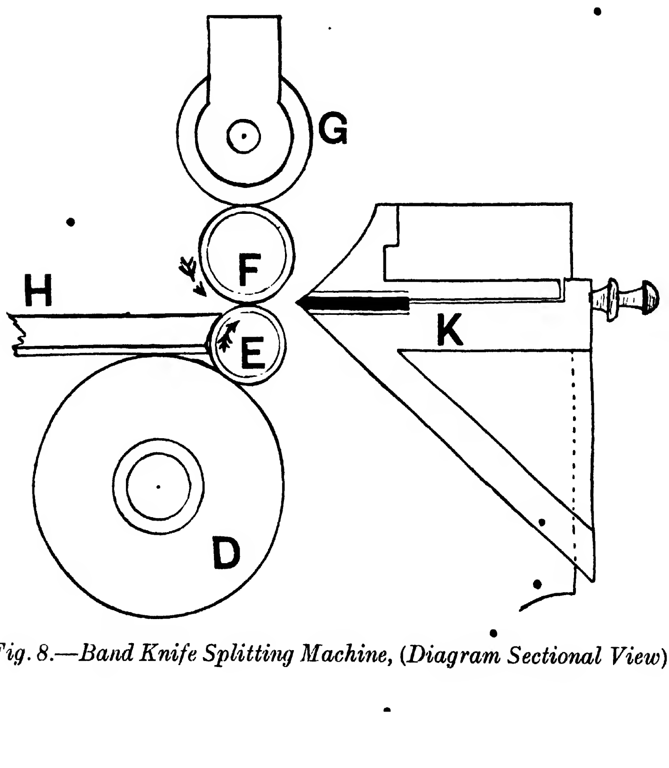

Fig. 8.—Band Knife Splitting Machine, (Diagram Sectional View).

§45. A, Fig. 6, is the main driving shaft; *a* is a bevel wheel fixed upon it. B is an intermediate shaft, with, fixed upon it, a larger bevel wheel *b*. The knife, an endless band, is stretched around two pulleys, one of which, C, is a fixture on shaft B. C^1 is the second of the two pulleys. The knife is *c*, *c*. The rollers are, D, Figs. 7 & 8, an india-rubber covered roller, E, Figs. 7, 8, 10, 11, a roller made in sections (sectional roller), F, same Figs., a nipping roller (upper nipping or gauge roller), and G, G^1, Figs. 7 & 8, steady or supporting rollers, sometimes termed friction rollers. H, Fig. 8, is the front section-roller plate, K, Fig. 8, one of the knife guide-jaws.

§46. In the band knife machines, adjustments are everything, as may well be supposed, and of the adjustments the operator must make himself thoroughly master. With the erection of the machine we have nothing here to do. Assuming the machine properly erected and the adjustments duly made, the machine does its work of splitting thus:—The piece of leather to be split is laid, grain side upwards, upon the section plate H (Fig. 8), which comes quite close up, but without touching it, to the roller E, its top surface being just below the top of the roller (see the Fig.). The rollers E and F turn in opposite directions. The machine being now started and the leather pushed forward, the rollers F and E lay hold of it, and, carrying it on, push it against the knife and the splitting is thus commenced. The operator does not lose control of the leather, but watching to see that it is going in straight, holds it if there is any pucker or overlapping, and puts this to-rights, or withdraws the leather if he thinks proper. If all is right, and the operator lets the leather go through the machine, then the top split passes upwards over the knife, and is received by an assistant, and the bottom split downwards over the back section plate L (Fig. 14), and falls to the ground.

§47. In the two splitting machines that have already been dealt with, the knife must be removed for grinding up, and ground apart from the machine. The belt-knife machine, however, carries its own grinding equipment, and does its own work of maintaining a keen-edged knife. The diagram, Fig. 9, is of a knife in

ction, ground with an edge which has been found by experience

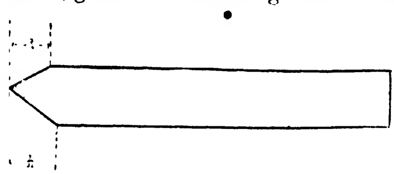

Fig. 9.—Band Knife in Section.

to be satisfactory on all classes of leather. The edge is double-bevelled, the length of the top bevel being three-sixteenths of an inch, and that of the bottom bevel a trifle nger, seven thirty-seconds of an inch. An illustration of the inding stones (or emery grinders) is not necessary. The inders are arranged in the under part of the machine, between e pulleys C¹ and C, and do their work of grinding as the knife sses from one pulley to the other, the knife being held steadily d evenly in grinder jaws provided for the purpose, and being eaned in its passage by thick felt cleaners. The grinders ust, of course, be kept in good condition, and not allowed to og with grease and dirt. They run at from 1,800 to 2,000 volutions per minute. Upon hard tannages a short-bevel knife eps its edge the best.

§48. The position of the knife edge in respect of the leather to be

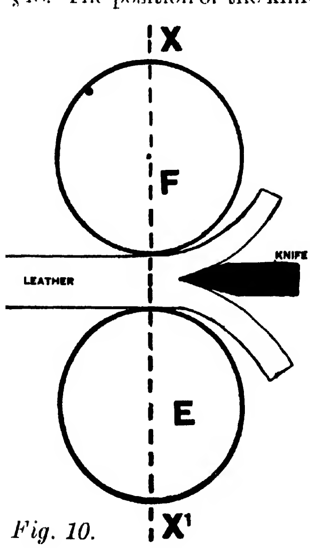

Fig. 10.

cut is a highly important matter. Fig. 10 represents the splitting of a thick piece of leather. The maximum compression of the leather is in the line X X¹, where the two rollers (here shown as of equal diameter), are closest together. The cut however cannot be taken where the compression is greatest, as the friction would heat the knife, and bind it as well as burn the leather. The knife is in its best position when its edge is as near the line X X¹ as it can be, to do its work without heating and at the same time give no more

than sufficient room for the two splits to clear the knife. If there is any more room than this sufficiency, it means that there is an unnecessary lack of rigidity in the leather between the position of maximum compression and the knife edge, means, that is to say, that bad splitting is being done, and that the resultant leather will be irregular in substance. In the Fig. 10, the knife is shown in proper position.

§49. Fig. 11 represents a piece of thin leather between the gripping rollers. Here the position of the knife is altogether wrong. The width of the piece of leather from the point of its maximum compression in the dotted line to the knife edge is such, that instead of the leather standing to the cut on being pushed forward by the rollers, it would try to double up on itself in the room it has for play between the rollers before it reaches the knife, and, instead of being split, would be cut through by the knife or be otherwise mangled by it. In adjusting the knife for splitting thin leather, the worker tests by several small pieces of leather of the same thickness as that he wishes to split, whether he has got the knife as near as he dare have it to the line of greatest compression, and it is only when he is satisfied with his test that he trusts his actual work to the splitting knife. Leather, hard or soft, down even to one-sixteenth of an inch in thickness, can be split in the band-knife machine with careful setting of the knife. One manufacturer makes an advertisement of a representation of an ox-hide, which underwent five splittings on one of their machines, of an ox-hide, that is to say, with six 'splits.'

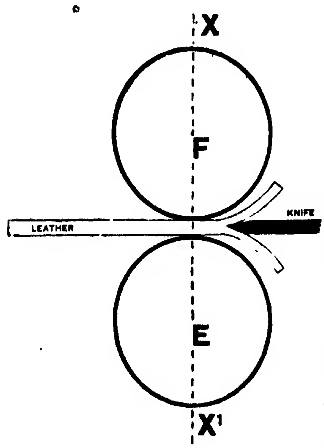

Fig. 11.

§50. Attachments.—Various attachments, for special purposes, have been invented and are manufactured for use with the Splitting Machine. By one attachment the knife can be run and ground without running the whole machine. Another attachment automatically grinds the knife whilst the machine is at work. Contingent on the class of work that is being split, it is claimed for this attachment that the operator may start his machine in the morning and work on practically continuously the whole day. Yet another attachment makes it possible to split stock either when tanned or straight from the limes and drenches.

§51. Sizes of Machines.—The Splitting Machines are made of various widths, from 36 inches up to 106 inches. These are *splitting* widths. The 36-inch machine is not much used; its first cost and up-keep make it nearly as expensive to run as a 57-inch machine. The power necessary to run a splitting machine effectively varies with its size. A 36-inch machine will need from 2 to 3 H.P. (horse-power); a 106-inch machine 8 H.P.

§52 Adjustments.—For putting the requisite tension on the knife for it to be driven by the belt-pulleys, one of the pulleys is adjustable. And both pulleys can be moved forward on their shafts in order that the knife edge may be moved forward as the knife becomes narrower by wear. At the back of each pulley there is a risen flange (Fig. 6). The blade of the knife when the machine is working, should run close up to these flanges, but not grind against them. If the knife is in proper condition it will cut freely and there will be practically no strain, and no need for the knife to be pushed up from behind as it were by the pulley flanges. Running close to the flanges the knife is ready to meet any unforseen strain that may arise and that may push it against the flanges. For keeping the knife duly forward in the knife-jaws as it becomes narrower, provision is made in the jaws themselves. It is only when the leather will not stand to the cut, because the distance from the line of maximum compression to the knife edge is too great that the pulleys need be shifted.

§53. To test the thickness of the splits, the operator makes use of a special gauge. It is here (Fig. 12) represented. The standard of thickness is the 'Birmingham wire gauge.' The sextant is graduated. The pressure of the thumb on the projecting knob lifts the top jaw, and brings down the index-hand seen (heavily shaded) on the left. Releasing the knob releases the top jaw, which then, by a spring, closes on the bottom jaw as far as the substance of the leather that is being tried permits, and the point of the index-hand indicates the thickness. The sextant is graduated both on side and face.

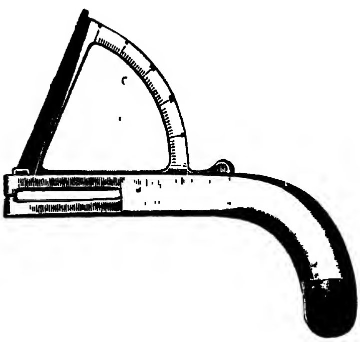

Fig. 12.

§54. The ornamental casting that spans the machine from side to side at its top (see Figs. 5 and 13), is called the 'bridge.' This carries the nipping roller F (Figs. 7 and 8) and the steady rollers G, G[1]; also its own regulating screws, one at each end of the bridge. It is by setting the bridge that the operator gets his splits of the desired thickness. In splitting a pile of leathers, the bridge may require adjustment several times. For, as the knife grinds away, its edge gets further back from the gauge roller and the substance of the splits increases, and this the operator remedies by regulating the bridge. While the knife is cutting well there is no need to move it forward by shifting the band pulleys. Regulation of the cut by shifting the pulleys is called for only when the leather shows a disposition to bend and escape the knife instead of standing to the cut. Some operators sort their leathers into three piles, one of the heaviest of the leathers, a second of intermediates, and the third of the lightest of the leathers. And this is good practice; because by working in this order, the knife as it wears away, is adjusting itself as it were for the stouter stock.

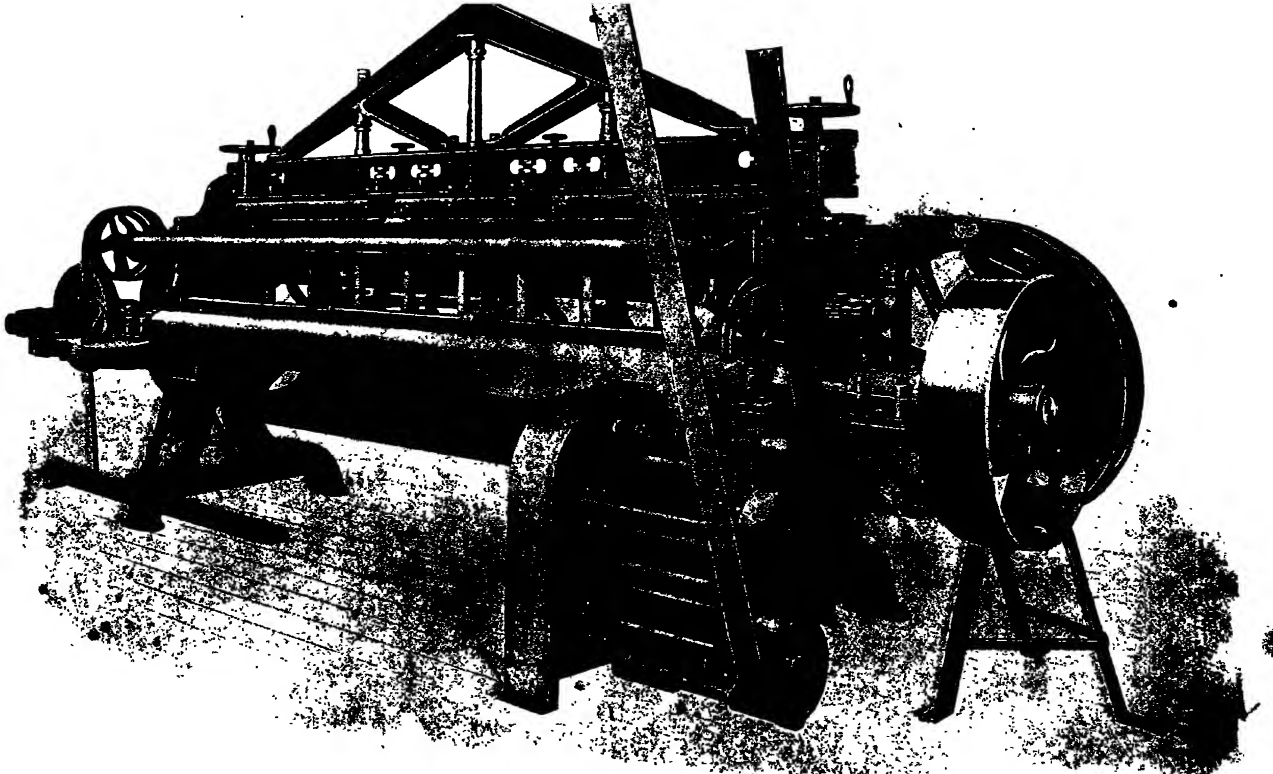

Fig. 13.—Band Knife Splitting Machine, (Front).

§55. CLEANING.—The whole machine should be cleaned down daily. If greased leather is split on the machine there should be special watchfulness, as grease decomposes india-rubber and the india-rubber roller will be spoiled. For this reason, sheep-skins are most undesirable things to split on the machine. It is well to keep the india-rubber washed with a solution of soda in lukewarm water, and from time to time when worn it should be ground up. As may well be expected with so delicate a machine, the quantity and quality of work turned out depend entirely upon precision of adjustment, and this precision is impossible in the absence of scrupulous cleanliness. The little bits of leather that get about the machine should be carefully removed. Such bits of leather have a knack of finding their way where they are not wanted and producing strain, and unfair strain on any part of the machine may be serious. The nipping roller F (Figs. 7 and 8) should occasionally be taken out and cleaned, and the steady rollers G, G^1, should be watched to see that they do not set fast. Only two steady rollers are shown in the Fig., but the number of the supporting rollers varies according to the size of the machine. These rollers slightly bear upon the gauge or nipping roller, and compensate for the upward thrust on the nipping roller caused by the pressure of the leather. When the machine is set for work, the operator should always be able to turn it by hand. If it will not turn by hand, it is either somewhere not clean, or it is binding somewhere, and to run it in such state means heating and mischief. The grinders too must be kept in proper condition, and not allowed to clog with grease or dirt. They are cleaned by means of an emery dresser held against their faces. Here again cleanliness is imperative, stoppage of the grinders whilst running has ruined many a piece of leather. The grinders must run quite freely and quite steadily. If they do not, then vibration is sure to be set up.

§56. SECTION ROLLER.—The section roller (E, Figs. 7, 8 and 14) is made up of pieces, as its name implies, and the sections, on their common shaft, move each independently of the sections adjacent to it. The leather to be split is put into the machine grain side

upwards (this has been already stated) and as the top split is the split that has to be of even substance, the inequalities of the leather on its under side, which must go somewhere, consequently descend into the section roller. The sections give way to the inequalities, being made elastic by means of the india-rubber roller D, on which the section roller runs and from which it receives its motion. The section roller should be kept perfectly clean; the sticking of any one even of the sections is sufficient to gall the leather. And it is advisable to change the places of the sections about every three weeks, placing those that have been at the ends of the roller in the middle, and so on. This tends to uniformity of wear.

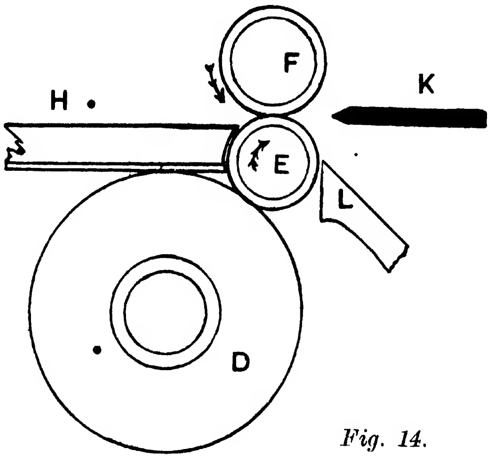

Fig. 14.

§57. The back section roller plate (L, Fig. 14), upon the edge of which the sections bear has to be carefully watched. For the edge wears by the constant friction of the sections upon it and it then allows them to fall out of position and good splitting is impossible. It is over this back section plate and under the knife that the bottom split takes its course.

§58. Speeds.—A safe speed at which to drive the machine, for all classes of leather, is from 250 to 300 revolutions per minute. The lubrication of the knife should be with petroleum, or some light good oil which does not clog. Care should be taken, in speeding up the grinders, not to run them at such speed as to risk their bursting; from 1,800 to 2,000 revolutions per minute is as high a speed as is safe.

§59. Though the steady rollers touch the gauge roller the whole of their length, they must not bind it. By at any time running the flat of the hand over the gauge roller, both that roller and the steady rollers should freely rotate. This tests their proper adjustment.

§60. The section-plate (H, Figs. 8 and 14) also plays an important part in accurate splitting, and has its own adjusting screws by which it can be lifted or lowered. It is over this plate, as will be seen from the Figs. 8 and 14 that the leather is fed into and taken up by the gripping rollers F and E.

§61. EULOGIUM.—The leather-splitting machine has been brought to a very high state of efficiency. To get perfect work with the machine, however, it must, so to speak, be wooed and won. The attentions and adjustments proper to it the machine insists upon and these tributes must be rendered unto it. Whoever thus pays court has his full reward, in the daily realisation of the exceeding pleasure that accompanies the turning-out of perfect work.

LEATHER SHAVING.

§62. The 'shaving' of a skin is the removal of substance from its surface by the slicing, paring, or sliding action of a keen-edged instrument. The operation is a necessary one; it remedies unevenness in a skin, and makes it throughout of uniform thickness. The shaving is of course on the flesh side of the skin. If the shaving is faulty the finish is imperfect. Particularly so if the goods are to be glazed, for irregularities of thickness then show up, the thicker parts of the leather receiving the heavier pressure and therefore the higher glaze under the glazing machine. Formerly the shaving of *skins* was done by hand entirely; now it is extensively machine work. The shaving machine will be presently explained, first, however, hand-shaving has to be dealt with. This being the universal method practised when *hides* are to be operated upon.

HAND-SHAVING.

§63. Fig. 15 shows a leather shaver at work. He has thrown the skin he has to shave over a 'beam,' and is shaving it with the knife that he is holding in both hands.

Fig. 15.

§64. BEAMS.—The 'beam' that he is working on, represented in section in Fig. 16, and with a skin E, over it, is of (mostly) hard wood, and has for its base or ground-piece A, a stout heavy block. To this at one end an 'upright' B, (which is *not* upright, but lies back three or four inches) is firmly secured. A piece of wood, about two feet long and eight inches wide, generally deal, C, is tightly screwed to the front of the upright, as shown, and to this is glued an outer piece of *lignum vitæ* D. Some makes of beam have no backing-piece C, but *lignum vitæ* only. A piece of board F, fixed as shown to the base A, raised behind by a small block, and with a heel-piece G on its upper surface, completes the beam. The face of the *lignum vitæ* is perfectly smooth, and the workman keeps it so, testing it frequently with a straight edge. Being constantly wet, and temperature constantly varying, the wood warps, and this

the workman has to be watchful against. In hot weather, to help keep the face in good condition, he leaves it of a night with a wet cloth wrapped round it.

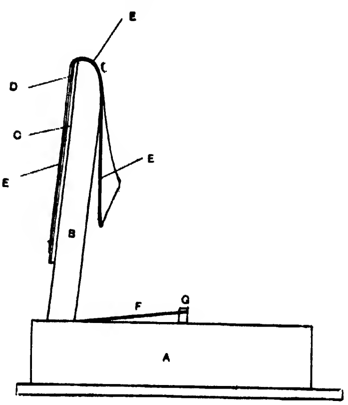

Fig. 16.

§65. The perfection of faces for a beam however is a glass face, and nothing but trade conservatism and trade prejudice stands in the way of its adoption. Amongst those unfamiliar with the glass-faced beam the opinion prevails that there is a liability of damaging the edge of the knife when the latter slips off the leather on to the glass; in use, however, this does not actually occur, the knife edge gliding over the glass surface without damage to the turned edge. Glass faces should be of plate glass not less than half-an-inch thick, ground in front, and with the top and sides well rounded off, and should have a countersunk hole at each corner, about one inch from the corner on a mitre line. The glass should be screwed to C with four brass screws, and bedded on white lead, upon which a little lamp-black has been previously dusted; a better method of fixing is by means of wooden pegs. If fixed by wooden pegs the glass can accommodate itself to any warping of the beam. With a black background, the workman can use the glass face as a surface plate upon which to test the truth of the knife edge. A glass face has none of the disadvantages of a wooden face, and for thin shaving is invaluable. Nor can cost be an objection, for the cost of a glass face is less than that of lignum vitæ. The writer has seen glass faces which after 40 years use are as good as when they were quite new. Wooden faces, in that period, must have been replaced at least a dozen times. The incompetent workman prefers the wooden face. If, when an end of his knife projects beyond the edge of the leather he is shaving, he catches that knife-end on the face of his beam,

he can scrape away and hide the evidence of his want of skill, suiting, in fact, his beam to his incapacity. So that his beam is smooth, its truth is quite a secondary consideration to him. A scratch on a glass face, to a good workman, would be a perpetual displeasure. The average life of a wooden beam is from two to three years.

Fig. 17.

§66. Fig. 17 shows another beam. The upright here is adjustable, and the workman can find for himself the angle that best suits him personally for his work of shaving and can fix his beam at that angle.

§67. The Knife that the workman is using, shown separately in Fig. 20 and in section in Fig. 19, has plate-steel blades of high quality steel, supported or framed by irons B, which are strongly screwed together with the blades between them, blades and plates thus becoming a rigid unity. This is the 'plate' knife.

§68. Other makes of knife used by the leather shaver are the 'solid' knife and the 'bar' knife. The 'bar' knife is shown in Fig. 18; A, the knife, being of steel, and the bars, B, of iron. The bars and knife are strongly riveted together. The 'solid' knife, Fig. 21, is a thin plate of steel welded up with two iron backings; the latter extending to practically the whole width of the steel plate. The irons in the plate and bar knives are suitably forged down at the ends to receive handles; in the solid knife the solid ends are forged down.

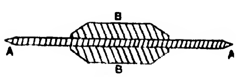

Fig. 18.

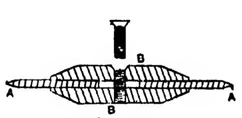

Fig. 19.

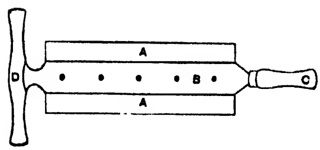

Fig. 20.

§69. The illustration, Fig. 20, shows the handles that are fitted to the knives; one of them C, is a straight handle, the other D, a cross handle. The tendency of the handle C to turn in the hand under the stubborn resistance of the leather is withstood by the worker's grip of the cross handle D.

Fig. 21.

§70. It is not however as knives are purchased from the trader that they can be put to their work, there is so to speak everything to be done to them before the leather shaver can use them.

§71. First of all a knife has to be ground up to a keen edge. This is done as follows. Holding the knife by both handles (see Fig. 22), the workman rubs one of the bevels of the knife upon a sandstone block. When new, the block is about one foot long, eight inches wide, and two feet high or thick. The stone represented in Fig. 22 is a stone worn down; worn down from an original thickness of two feet to a thickness of about six inches. In the matter of method of rubbing the bevels, experience gives its sanction to the following. The observations apply to all three kinds of knife; the Fig. shows a plate knife. The workman keeps nearest to him that knife edge on which is the bevel he is rubbing down, and, so that the whole

Fig. 22.

length of the bevel may be taken by the narrower stone, he disposes his knife diagonally with respect to the stone. The bevel being in contact with the stone, the knife edge that is farthest

he can scrape away and hide the evidence of his want of skill, suiting, in fact, his beam to his incapacity. So that his beam is smooth, its truth is quite a secondary consideration to him. A scratch on a glass face, to a good workman, would be a perpetual displeasure. The average life of a wooden beam is from two to three years.

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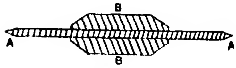


Fig. 18.

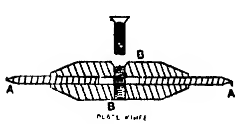


Fig. 19.

§73. The iron supports (bars) in the bar knife are much narrower than the irons of the plate knife, and the steel of the knife extends considerably beyond the bars. As the steel grinds away, it is evident that the knife becomes narrower and lighter. Eventually the steel grinds down to the iron; the rubbing is laborious, and the knife to all intents and purposes is a solid knife. The solid knife is almost obsolete, although, because of its solidity, it is a very safe one; this pattern of knife is sometimes preferred when heavy or hard leather is being dealt with.

§74. The solid knife also becomes narrower and lighter as it wears. And where it is necessary to employ a large knife, either bar or solid, not the least of the drawbacks of such knife is that as soon as it gets into use it begins to decrease in size and weight.

§75. Of the three knives the plate knife is undoubtedly the most economical, though most expensive at first. It combines the keenness of the bar knife with the safety of the solid. For some purposes where a very small knife is required, the solid knife is indispensable.

§76. In the operation described above of grinding the bevels on the rubstone, a fine thread or 'wire' forms on the extreme edge, and it is by the feel of this 'wire' that the workman judges when he has rubbed enough. This wire has to be carefully got rid of. The removal is effected by a 'clearing stone,' a stone of much finer grain than the rubstone. Again the bevels of the knife are rubbed firmly backwards and forwards until the scratches of the rubstone disappear. In thus 'clearing' the edge, it is usual to slightly raise the knife on the bevel that is being rubbed, so that a width of only about one-eighth of an inch receives the 'clearing.' Finally, all the rubstone marks having been removed, the extreme edge of the steel is lightly drawn across the stone to remove the very fine wire that remains. Clearing stones are fashioned into various shapes according to the work they are for. Often they are used by hand, as in the 'clearing' of the 'Union' Machine knife, above (§35) referred to, or, to take another example, as in the case of the sharpening of a scythe.

§77. Of clearing stones for the knives we are now dealing with there are three kinds used in the trade, the Welsh stone, the Water-of-Ayr, and the American. The Welsh are round in shape and about eight inches in diameter, and these when regular in their formation and not too hard are excellent. But they have a tendency to irregular formation and when very hard they will not 'fret' properly, that is to say, will not permit the knife to *bite* as it should do upon them. When a stone 'frets' properly, it wears away, just as, indeed, human life wears away by fretting, in another sense of the word. They cost about fourpence per lb. A Welsh stone is seen in Fig. 22. In grinding on a circular stone the workman can start the stroke of his knife from any part of it. Working thus he keeps a flat face to the stone.

§78. The Water-of-Ayr stone is a square with the corners taken off. It is an excellent stone for fretting and giving a very keen edge. A serious drawback to its value, however, as a clearing stone, is its tendency to split, especially in view of its high price, tenpence per lb.

§79. The American stone is to be strongly recommended, because of its uniformity of structure, and its low price, fourpence per lb.

§80. Even yet the knife is not ready for the leather shaver, and now comes the most important part of its preparation. The edge of the knife having been cleared, *it has to be turned.* The edges of a plate knife, as turned, are shown in Fig. 19. The turning is done by a piece of round steel, made extremely hard and perfectly smooth, about five or six inches long, and with a handle at each end. This is shown in use, in Fig. 24. To turn the edge of his knife the workman places himself on his knees (see the Fig.), rests the end of the straight handle of his knife against some rigid body, and takes the cross handle between his knees. Thus holding the knife he has it quite steady and at the

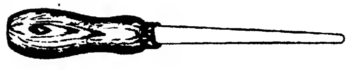


Fig. 23.

same time has his two hands at liberty for using the turning steel. Grasping this as seen in Fig. 24, and with the edge of the knife quite clean and tallowed, he rubs with pressure three or four times along the knife, the whole length of it, *behind* the edge. In this way he starts the turning of the edge, and he does the rubbing usually with a forward stroke only. The pressure he exerts is mainly with the hand that is behind the edge, though the hand that is in front of it assists and guides, both hands moving parallel to the knife edge. The workman now raises the knife a little by means of the cross handle, and rubs along the slightly turned edge, thus turning it a little more. And so, by successive stages raising the edge of the knife until the cross handle between his knees is nearly upright, and at each stage rubbing along the edge with lessened pressure, he turns the edge completely over, (see Fig. 19), and it stands almost perpendicularly to the knife. The turned-over edge is but a mere 'wire' after all, seldom more than $\frac{1}{32}$ of an inch deep; but there is all the difference between the wire that comes of the rubbing on the sandstone and this wire fashioned by the burnisher, that there is between the torn edge of a piece of leather and an edge of the same piece of leather cut with a keen blade.

Fig. 24.

§81. The turning steel just described is the turning steel of commerce. But quite commonly the workman makes his own, out of a five or six inch three-square taper or parallel file. He grinds the teeth out of the file on all three sides, gets the sides up perfectly smooth and burnishes them, and then fits a handle to the tang. The file is now itself a burnisher, and the workman taking the handle in his right hand uses it as a turning steel, steadying his stroke with the fingers of his left hand on the file end. Fig. 23 shows a steel made as described.

§82. It is customary in the shaving of morocco leathers to oil the goods on both flesh and grain sides before shaving. The oiling on the grain side helps the leather to run out smooth before the knife during the shaving, so that there shall be no pleats in the skin; and the oiling on the flesh side eases the cutting. A favourite oil amongst shavers of bookbinding and furniture leathers to thus use is seal oil. Any common quality of oil whether serviceable or not, providing it is light in colour, is sold to morocco shavers under the name of seal oil; and oil so passed off is usually largely adulterated with mineral oil. In the writer's experience either castor oil thinned down by the addition of a small quantity of petroleum oil, or a good quality of heavy petroleum engine-oil, is very satisfactory for the above use, minimising the risk of staining and being cheaper than seal oil.

Fig. 25.

§83. A beam of another kind is the 'French' beam. This beam is about four feet six inches long. In its essentials it is the same as the upright of the beam just described. It is fixed to the workshop floor at the fore end, and has a leg at about the middle reaching from beam to floor, so fixed that the beam stands at an

angle with the floor of from 30° to 35°. The workman in Fig. 25 is shaving on a French beam. It is used principally for heavy leather such as harness butts, etc. A heavy hide on the upright, B, of Figs. 15 and 16, would hang about it in pleats and folds, and be in the workman's way owing to his inability to fold it round the back of the beam. On a French beam, as shown in Fig. 25, the leather is thrown over the beam and falls down at its sides, and thus, in no way obstructs the workman.

§84. The operations above described are all of them difficult to become expert in. With these difficulties, however, to commence upon the learning of leather shaving begins. And expert in them all a workman must become before he can start the shaving of a skin with a knife prepared by his own hands. The learner's next difficulty is that of the actual shaving operation.

§85. The carpenter who shaves ('planes') a piece of wood, adjusts his knife ('plane-iron') so that it projects in such degree beyond the face of the plane, as will bring about a wooden shaving such as is proper to the work he is engaged upon. He has but little to do after that other than take stroke after stroke with his plane, the cut he gets being constant. The carpenter's work of 'shaving' is simplicity itself as compared with that of the leather shaver, the cut of whose knife is not decided for him, but has to be decided *by* him, and that at every stroke he takes, and is only constant as long as by sheer muscle he makes and keeps it so. The stroke of the leather shaver's knife must be parallel to the face of his beam, and to keep it thus parallel, strength does duty for the solid wood of the carpenter's plane. If muscle yields at all then the stroke of the knife is uncertain to the extent of the yielding, and there is unevenness in the finished work.

§86. The leather shaver's way of working will be seen by a a reference to Figs. 15 and 25. Wearing a leather apron he stands upon the inclined board on the base A of his beam (Fig. 16), with his heels against the heel piece fixed to it. This gives him a purchase or fulcrum to work from, and he now presses his knees against the skin E. As he leans over the top of the beam (Fig. 16), in order to apply the knife to the skin he has to shave, he further presses against the skin with his body.

Then with the knife in both hands, and so disposed that the wire of it which he purposes to shave with is undermost and presents forwards, he shaves the skin (Figs. 15 and 25) with a downward stroke, pushing the knife from him. The cross handle is always held in the left hand, a wire edge thus always presenting forwards; the right hand grasping the round handle (Figs. 15 and 25). Leather offers heavy resistance to cutting, and the pressure the workman is exerting upon the skin with knees and body withstands the drag of the resistance and prevents the skin being pushed forwards. The wire edge of the knife is so delicate that it very quickly, in a few minutes, loses its keenness. The experienced workman tells at once by the feel of his cut when his knife is not working as it ought to work, and he proceeds to restore its keenness—with yet another tool.

§87. The tool he now employs is shown in Fig. 26. It is a piece of steel wire, perfectly clean and smooth, carefully tempered, and with its end or point a half sphere, like, say, the extremity of a small hanging drop of water. The wire is fixed in a wooden handle. Because of the difference in the sizes of knives and of the slight variations in the depth of the turned over edges, the workman has three of these steels, of wire respectively Nos. 13, 14, and 15 'Birmingham Wire Gauge.' The largest, No. 13, is of wire about one-tenth of an inch in diameter, the smallest of about one-sixteenth of an inch. Choosing that one of his steels that is best suited, he runs it along the groove formed by the wire edge with the body of the knife, and then along outside this turn-over edge. It is along the outside that he is rubbing in Fig. 27. By a few light strokes thus he renovates the edge of the knife and restores its efficiency; and so applying his steel frequently, almost as it

Fig. 26.

Fig. 27.

were involuntarily, he is able to use his knife for hours without going to the rubstone again. During the actual shaving the steel is held between the fingers of the right hand (Figs. 15 and 25).

§88. The acquisition of dexterity in the application of this steel bodkin to the edge of his knife as this becomes dull is another difficulty that the leather shaver has to overcome. From the very beginning to the very end of his learning his trade he is beset with difficulties and confronted with operations that it is up-hill work to become skilful in. In addition to that, the work is dirty and laborious, and it deserves remuneration on a high scale.

§89. A further word on the French beam. As stated above, the workman leaning over the end of the beam presses against the leather that he is shaving. Manifestly the end of the beam must be low enough for him to do this, and the French beam being long, has to be fixed at a small angle with the floor so that the working end of it may not be too high for him to stoop over and lean against.

MACHINE SHAVING.

§90. The Fig. 28 is of a machine-shaving shop, and shows eight machines, of the older type of construction. The machine

Fig. 28.

does to a skin that which is done by hand-shaving, but much more quickly. Fig. 29 is a view of one of these machines taken from the back end of it; and Fig. 32 shows it in side elevation and part section. Formidable though the machine may look at first sight, yet, essentially, so far as the actual work of shaving is concerned, it consists simply of two rollers: one a cutting roller, furnished with steel knives, and the other a roller covered with india-rubber. The diagram, Fig. 30, shows in section the two essential rollers and two other material parts of the machine, on larger scale.

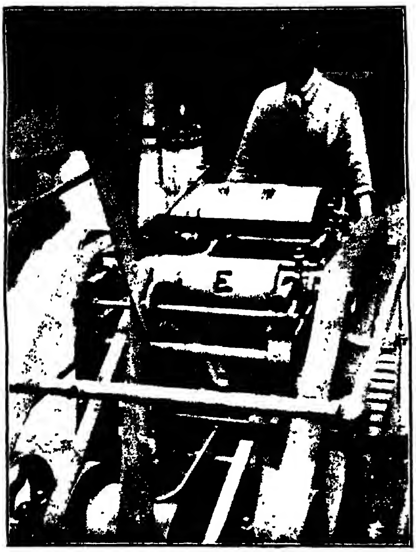


Fig. 29.

§91. In Fig. 28 the knife or cutting roller, at A, is hidden by the machine cover; it shows, partly, under the cover of the machine, in Fig. 34; and its position in the machine is shown in Figs. 32 and 30. B (Figs. 28, 30, and 32; also Fig. 31) is the india-rubber roller. Cutting rollers, the top one of many blades, the under one of seven blades, are shown separately in Fig. 31. The knives are arranged spirally on a cylinder, half being right-hand spirals and half left-hand. This disposition of the knives keeps the leather spread, and at the same time gives knife-surface.

§92. In the sectional diagram, Fig. 30, (also in Fig. 32), the further parts C and D of the machine are represented. Manifestly, if knives are to cut they must be sharp and must be

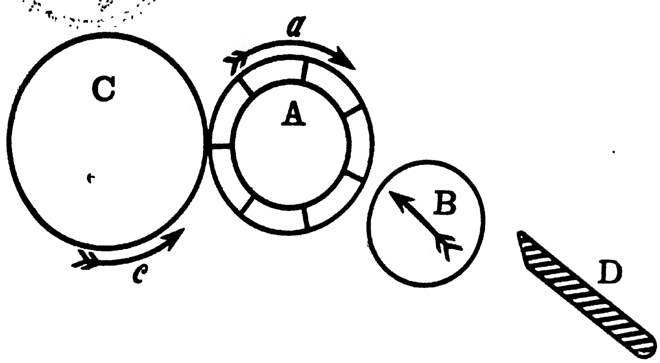


Fig. 30.

kept sharp, and C is the emery grinding-wheel by which this sharpening is effected. It partly shows under the knife-guard in Fig. 29. The emery wheel is thin and drives at a high speed from the drum E (Figs. 29 and 32): it has further a backward and forward traverse across the machine, so that the knives in their whole length may come under its abrasive action, and also has an adjustment to keep it up to its work as it wears away. As shown by the arrows *c* and *a*, Fig. 30, the emery wheel and the knife roller revolve in opposite directions. In its grinding of the knives, the emery wheel forces up on the top edges of their faces as they successively reach the wheel a fine sharp burr or thread of steel, a 'wire.' In some machines the cutting cylinder and the emery wheel revolve in the same direction and this burr of steel is consequently thrown up on the under edges of the knife faces.

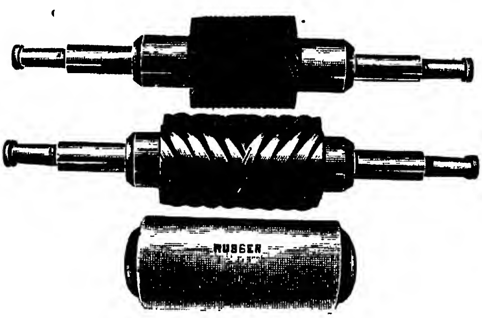


Fig. 31.

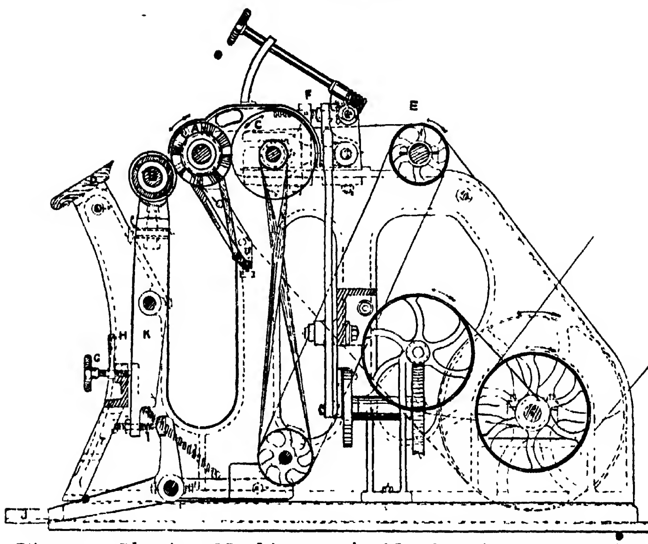


Fig. 32. Shaving Machine, part side elevation, part section.

A Shaving Cylinder Knives.

B India Rubber Covered Roller.

C Emery Grinder.

D Adjustable Table.

E Drum for Belt to drive the Traversing Emery Grinder. (Also see Fig. 29.)

F Screws for moving Grinder to Knife.

G Hand Wheel and Screws for adjusting Roller to Knife.

H Lever for locking Screw G.

I Treadle Adjusting Screws.

J Foot Treadle for giving movement to K.

K Rocking Frame for Roller.

§93. D (Figs. 30 and 32), is a wooden table to receive the skin which is to be shaved, (and see also Fig. 34). All machines are not furnished with this table, but one of the stretcher-bars of the machine takes its place, the stretcher-bar at top, extreme right, in Fig. 33, and at top, extreme left, in Fig. 36. This, however, is bad form; the contact of a wet skin with wood is unobjectionable, but the contact of a wet skin with an iron stretcher-bar brings in a possibility, even if remote,

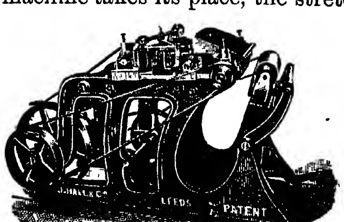


Fig. 33.

of mischief to the skin which will show itself up in the finished leather in the form of 'iron stains.' In practice, consequently, the operator often covers up the bar, say with a piece of leather. This is effective, but unsightly; what should be is the wooden table.

§94. The action of the machine is as follows:—The roller B (Figs. 28, 30, and 32), is in a rocking frame, the direction of the rocking is shown by the arrow, Fig. 30, which passes through the roller centre. By the rocking, the extent of which the operator controls by a screw, I, Fig. 32, the distance between the roller B and the roller A is regulated. The rocking frame is actuated by means of a treadle, the foot portion of which, J, Fig. 32, is seen at the extreme end, left hand, of Fig. 34. The carriage-step iron, in contiguity to the treadle, is not a portion of the treadle, but is a foot-rest. The operator lays the skin to be shaved on the table D and over the roller B, between that roller and the cutting roller, the skin hanging partly also over the ends of the rubber roller. Then resting the sole of his boot on the carriage-step iron he pushes the treadle down with his heel; this brings the rubber-covered roller B up nearer to the knife roller A, but not near enough, suppose, for the knives to touch the skin. The operator now, by means of the controlling screw, closes up somewhat the distance between the two rollers, and, again applying his heel to the treadle, sees if the skin comes close enough up to the knives for these to bite on the skin. The rubber roller can come no closer to the knife roller than it is brought by the rocking frame.

§95. When the adjustment between the two rollers by means of the controlling screw has been completed, and the knives press upon the skin on pushing down the treadle, the skin is carried forward by the pressure, and the rubber-covered roller, which is loose in its bearings, turns by the friction of the skin upon it. The rate of movement of the skin is that of the knife roller; there is pressure upon the skin but no cut; the skin simply runs idly through the rollers and drops down behind the knife roller. Now the operator, lifting his heel, releases the rocking frame which flies back by a spring. Again putting the skin in place for

shaving, and giving a push to the treadle, the operator brings the skin up to the knife roller, but, instead of allowing it to move forward uncontrolled he holds it back, and only permits it to move forward at such speed as he chooses. The knives now are moving faster than the skin. If the keen burr of steel, the 'wire'

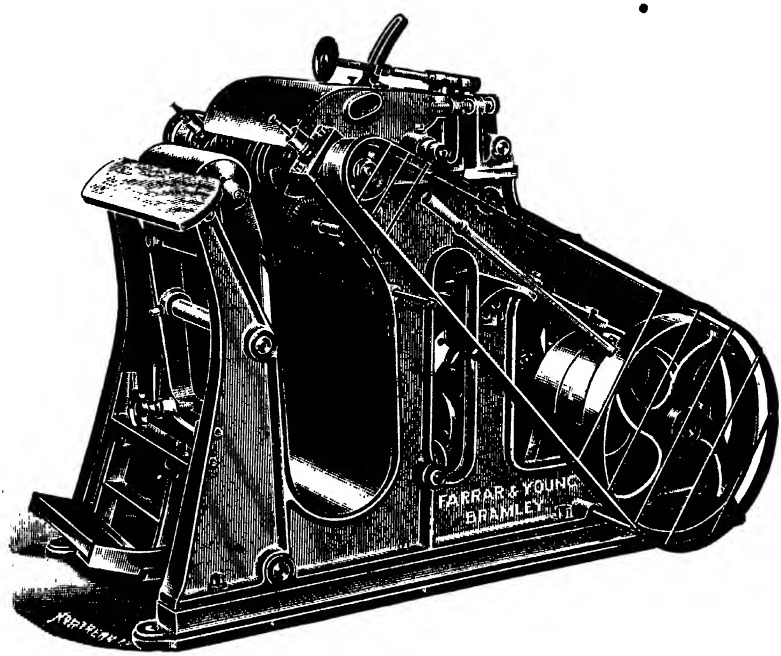


Fig. 34.

spoken of above, presents forward to the skin, then the skin is *shaved*. If, however, in sharpening the knives the emery wheel has revolved in the same direction as the knife roller, then the wire presents backwards and plays no part on the skin; the front square edges of the knives do the work, and the skin is not shaved but *scraped* only.

§96. Some of the latest shaving machines have a smooth metal cylinder, nickel-plated, in place of the rubber-covered roller. Such a cylinder is by no means suitable for all purposes; it is most suitable for chrome leathers. The roller to be preferred is that of hard rubber.

§97. In a cylinder of many knives, (Fig. 31, the top one of the three illustrations), these are necessarily of thinner steel than when the number of blades are few. The thinner the knife the sharper the cut, but upon heavy goods a thin knife would break. The number of blades is a matter of importance. Cylinders are now fitted with knives from seven left hand and seven right hand, up to 24 left hand and 24 right. With a large number of blades a fine cut is obtained. For ordinary shaving seven blades each, right and left, is a good number. For flatting, a cylinder of ten blades right and ten left is required; for whitening, a cylinder of from 10 to 14 blades each hand; and for buffing, a cylinder of from 18 to 24 blades right hand and the same number left hand.

§98. The operator at a machine should always when he starts his work so adjust the rubber roller that the knife will take at one cut all he wishes to shave off. It is difficult to get a satisfactory cut a second time on a part that the machine has already gone over, and this is particularly the case with chrome leather. The workers of shaving machines may be said to have each his own favourite method of procedure. Some operators will work a skin from the edges to the middle, others will reduce the thick parts first, and then work over the rest of the skin and others will take the thick parts last.

§99. A final word of caution is necessary. The worker who becomes possessed of, or has to learn how to use, a machine, must not suppose that the machine is going to do his work for him and relieve him of all care, and that he has merely to let a skin go through, and he will be happy ever after. The illustration Fig. 35 is of a skin which has been haggled and 'ribbed,' as it is termed, very badly by going through the machine too fast, that is to say the worker has not had the skin under proper control. There is a range of speed at which

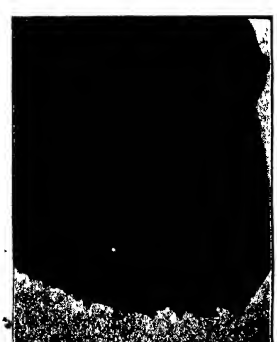


Fig 35.

a skin can be fed through a machine, not a hard and fast line of speed, but a latitude as it were, the required speed being to some extent dependent upon the nature of the particular skin that is being shaved. If a skin is fed into the machine too slowly, it grinds and packs the leather. A machine has no brain; the user must be brain for it; there is plenty of need for the exercise of intelligence; and the operator will need much experience in order to be sure beforehand that he is going to obtain the best results that the machine is capable of.

§100. In shaving by machine it is extremely important that the goods should be in right condition for it, neither wet enough to stick to the rubber-roller, nor dry enough to 'fire'; that is, to scorch by the considerable friction that is set up; for the knife-roller rubs heavily upon the leather, irrespective of the resistance the leather offers to the cut. Before using the machine at any

Fig. 36.

time, the knives should be sharpened by a few turns of the emer wheel upon the knife-roller. In no case should goods be shave whilst this sharpening is being done.

§101. The Fig. 36 shows a shaving machine of later type There is no drum E in the machine, and the cutting roller receive its motion direct from the main driving pulley. A particula feature of the machine, as compared with machines of olde design, is its rigidity. The single casting that constitutes it main framing is of a section that does not lend itself to vibration vibration will always rib a skin. At the lower front of the machine are two handles. That on the left strikes the driving belt on or off, that on the right puts the grinding out of gear when not required.

§102. The grinding dust, consisting of fine particles of steel and emery, is removed in some machines by a fan, so that no damage may be done to the leather by the particles. The fan works automatically. The brush under the knife roller in Figs. 34 and 36, prevents the skin catching on to the roller and being drawn around it.

§103. It will be found by up-to-date manufacturers that machine-shaving in the hands of a competent workman is far more economical than hand-shaving. Still the shaving machine is not everything. Where feeling is indispensable a machine can only grope its way. Hence it comes that all the best moroccos are shaved by hand, especially if for upholstery purposes. Neither can hides be machine shaved because of their size and weight.

SCOURING.

§104. Hides and Kips.—Goods after being shaved are ready for scouring. Scouring has for its object the complete removal of 'bloom,' and is usually carried out by working over the surfaces of the leather, both grain and flesh, with a 'slicker,' and also well brushing the hide with a stiff brush, plenty of warm water being used both with slicker and brush. 'Bloom' is an incrustation

which forms on skins from their being tanned with materials belonging to the pyrogallol class, and consists chiefly of ellagic acid. In colour it is brownish yellow, and it occurs in tannages by oak bark, myrobalans, sumach, valonia, etc.

§105. A solution of soap has considerably solvent effect on ellagic acid, it is therefore advisable to add a small quantity of soap to the warm water used in the scouring; a suitable quantity being about 4 ounces to each 3 galls. of water.

§106. In cases where the goods are heavily bloomed a little borax should be added to the scouring liquor.

§107. The hide or kip to be scoured is placed, after soaking, on the scouring table, flesh side up, with the ridge near the top side of the table, half the hide being scoured over at one time. The flesh surface is 'scoured,' as it is technically termed, with a steel slicker (sleeker). The tool is represented in Fig. 37. The top part is of wood, and the operator, taking hold of this with both hands, slicks (sleeks) the hide in successive strokes. The action of the tool is intermediate between a rub and a scrape, and the operator first works along the ridge of the hide, and then from ridge to shank, so as to set out the hide quite flat. When the one half has been thus smoothed out, the hide is turned round and the other half slicked from ridge to shank.

Fig. 37.

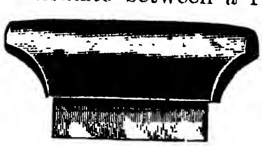


Fig. 38.

§108. The flesh side of the hide having been well scoured in the way explained, it is again thrown into the soaking tub. When removed it is laid on the scouring table grain side uppermost, and this side is slicked well over just as the flesh side was. But the slicking tool now is a sharp stone, Fig. 38. (Fig. 39 shows a workman using a stone slicker). When this is done, the warm soap solution (§105) is thrown over the hide, a brush

Fig. 39.

Fig. 40.

(Fig. 40) takes the place of the stone, and the grain side is well brushed so as to work up all bloom and dirt to the surface, whence its removal is easy. (A workman using a brush is seen in Fig. 41). The bloom deposit and dirt having been washed away, the grain surface is gone over with a steel or brass slicker, and the hide is then ready for succeeding operations.

Fig. 41.

§109. Scouring is also done by machine; but machine work is only to be recommended in the case of goods that are to be dressed for blacks, or on the flesh side only. This is because the machine does its work in so vigorous a manner that it is almost impossible to prevent damage to the grain surface. For scouring the flesh side of heavily bloomed goods, the scouring machine is of great utility. The two more generally used scouring machines are the

Fitz-Henry or Jackson Machine, (Figs. 44 and 47), and the Burdon Machine, (Figs. 42 and 43).

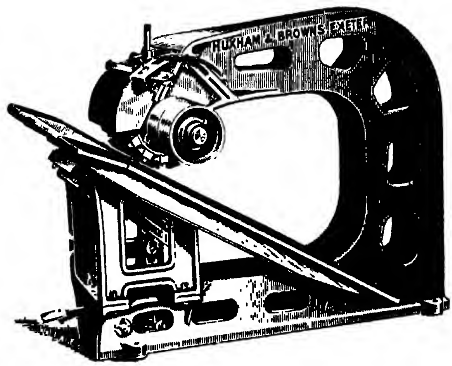


Fig. 42.

§110. The Burdon machine is simple in its construction. The lower portion of the framework carries a sloping table, on which the hide is placed, and the upper portion carries a drum, round the periphery of which stones and brushes are fixed alternately. On the same shaft as the drum a pulley is fixed, as shown in the Figs., and this pulley is made to revolve at a speed of about 500 revolutions per minute. The leather is fed up to the revolving drum by means of a foot lever, which lifts the table and the hide or kip upon it, and the operator works the hide about under the revolving head, pulling the hide against the drag of the revolving tool. If he happens to let go, the hide falls to the bottom of the table. It is customary to have a stream of water running on the leather whilst the scouring is in progress, and the machines have an attachment befitting such purpose.

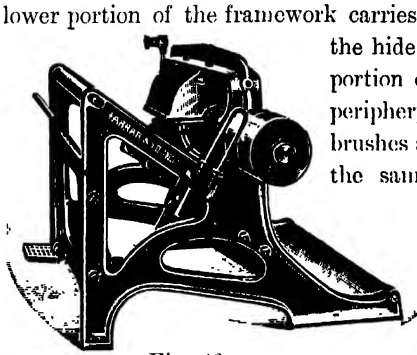


Fig. 43.

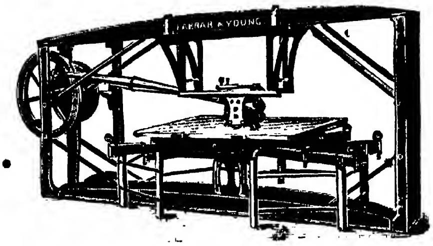


Fig. 44.

§111. In another kind of machine, represented in Fig. 45, the stones that do the scouring are fixed in regular succession and at short distances apart upon an endless band, which is stretched around two flat-rimmed pulleys that are in line one with the other. In the machine described in the last paragraph the stones, being part of the revolving head, move circularly, and as each stone comes down upon the leather, it first of all touches, and then exerts pressure upon the leather through a very small curve, the pressure becoming a maximum at the lowest point of the curve, and lessening to nothing after that point is passed. At this lowest point the rub on the leather comes near to being laceration. The stones in the machine now under notice move in a straight line parallel to the table, and the rub is quiet and soft.

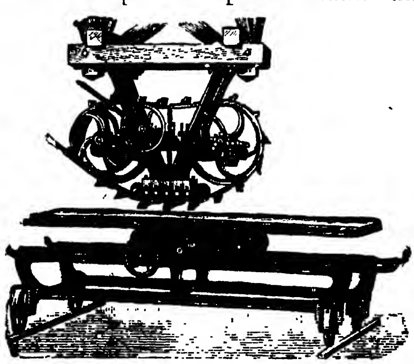


Fig. 45.

On the shaft of one of the two pulleys there is also fixed the pulley around which the belt passes that gives motion to the head. The second of the two pulleys of the head receives its motion from the stone-fitted belt itself. The table that receives the leather runs upon wheels, and can be moved easily in several directions, so that the leather may be shifted in position with respect to the rub of the stones, which

is of course always, as will be seen from the Fig., in one and the same straight line. •

§112. The all-important part of a scouring machine is necessarily the head. In the Fitz-Henry Machine, the head, of which Fig. 46 is a side elevation, has a backwards and forwards motion. On a transverse shaft F which has its bearings in the machine head, is the frame E, to which the tool carriages B are hinged, two at each end of the frame. To one end of the frame the free end of the crank-rod (not shown), from which the machine head receives its motion, is attached, and the frame in this way partaking of the motion of the crank rod, has a rocking movement. When the crank rod commences to lift, which should be when the machine head is at the near end of its stroke, the tools at the far end

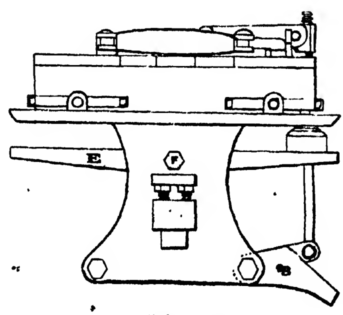


Fig. 46.

of the rocking frame are pressed down upon the leather. The pressure increases as the crank rod rises, and is at its maximum when the rod is at its highest point, after which the pressure decreases till the rod is at its dead point, the head being now at the far end of its stroke. The crank continuing its revolution,

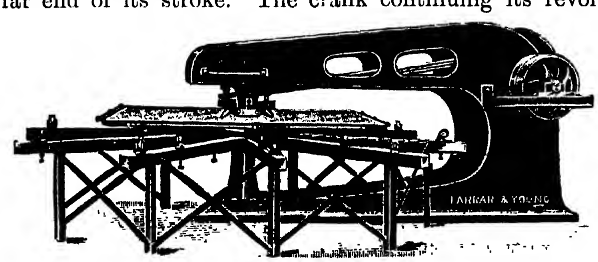


Fig. 47.

carries the crank rod downwards, and the tools at the near end of the frame are pressed upon the leather, which pressure reaches its maximum when the rod is at its lowest, and then decreases till again the machine head is at the near end of its stroke. The scouring is thus always with the push of the stone.

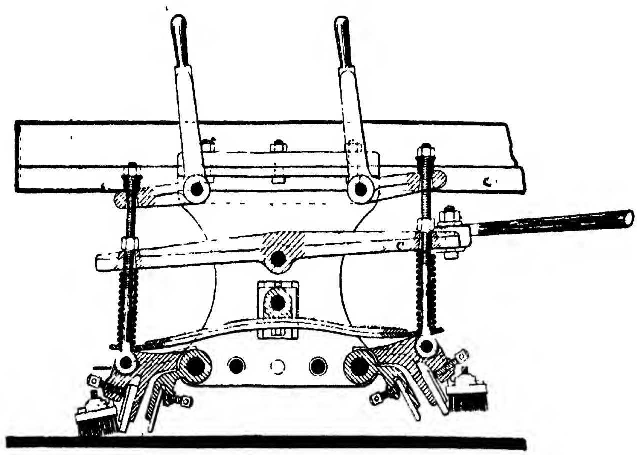


Fig. 48. Jackson Machine-Head.

§113. Such was the original American machine, introduced into this country about 35 years ago. An improvement was patented by W. L. Jackson, in 1884, the object of the improvement being "to produce a more uniformly sensitive pressure" of the tools upon the leather that is being scoured. Fig. 48 shows a part machine head as constructed under this patent. In this Fig. the attachment of the crank rod to the working frame is represented, also the tool holders, carrying each two stones, and so constructed as to also each carry a brush, the action of which precedes that of the stones.

§114. After the Jackson patent had run out machine-heads various (Figs. 49 and 50 show two of these), were placed upon the market. The scouring in all of them is done with the push of the stone, and the stones therefore make but a small angle with the horizontal table.

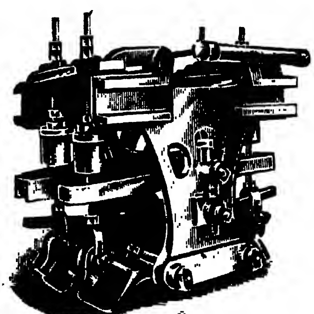


Fig. 49.

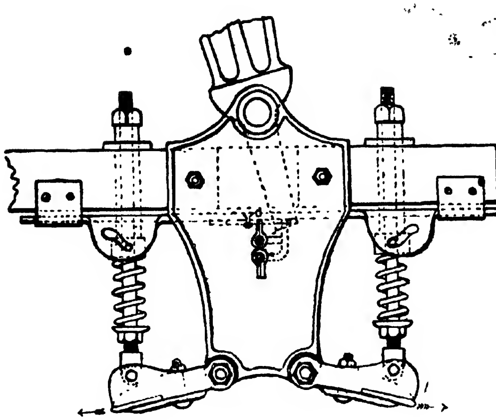


Fig. 50.

§115. Apart from the rocking motion of a scouring machine-head, its movement should of course be horizontal, parallel, that is, to the surface of the table upon which, underneath the machine-head, the leather rests that is to be scoured. The several methods by which such horizontal motion is secured need not be described, the matter is of no importance here.

§116. Nor are the methods by which the table with the leather upon it is lifted to the machine-head, of any consequence here. In respect of scouring-machine tables, every maker has his own. The idea underlying them all is to secure as great as possible a freedom of movement in all directions. A sort of skeleton framework stands on the floor independent of the actual machine, and the top bars or arms of this frame, carry swivelling castors. The table rests upon these castors. A complete scouring machine, with iron framework, is shown in Fig. 47, and a machine of another pattern, which however is not so convenient in actual work, in Fig. 44.

§117. Another matter that does not call for detailed description is the various methods by which adjustments may be made. It is sufficient to note that in all the machine-heads there is provision for adjustments of stone or brush, and for regulating their

pressure on the leather; also for lifting them, one or all, out of working, without stopping the machine. The stroke given to the heads is from 18 to 24 inches, or thereabouts, and driving pulley runs at about 150 revolutions a minute, each revolution giving a movement to the head both backwards and forwards. Some machine-heads are furnished with a central brush, which, at the option of the worker, either remains down on the leather during the stroke, or may be held up from the leather.

Scouring of Bark-Tanned Calf.

§118. Calf skins, to be suitable for colour work, should be chosen (wherever possible), by their freedom from bloom. On the other hand, the skins that are most suitable for dressing into wax leather, §1040, are those that have been well tanned with bloom-giving tanning materials (pyrogallol tannins), as goods so tanned will carry more grease than if tanned with the materials (catechol tannins) that are not bloom-giving, especially if these have been used in excess.

§119. The goods, for whichever above purpose, may after shaving, be in many cases advantageously tumbled in the drum with a little warm water, for about 30 minutes. This treatment, which of course means the attrition of the skins against each other, 'scours' them. The addition of a small quantity of borax to the water used in the drumming as just above recommended, is also advantageous in facilitating removal of bloom (§106).

§120. The scouring of calf skins is almost always done by hand. When, however, the goods are to be dressed for wax finish on the flesh side, the Burdon Scouring Machine (§110), may be advantageously employed in the preliminary stages of the scouring. The scouring by hand is carried out in similar manner to that described for hides (§104). Very great care must be taken in the scouring of the grain side of calf skins, which is always inclined to be tender. Many manufacturers omit the stoning entirely, and instead of it use a mop or brush made of the fibre used by gardeners for tying up plants—that sold under the

name of 'bass.' Such mopping or brushing is very effectual, and the goods may in this way be well scoured without any danger of damage to the grain.

§121. After scouring free from bloom the goods are rinsed through clean water, and then preferably given a light sumaching in the drum; after which they are ready for dyeing if the shades required are dark tones, such as tan browns, chocolates, dark greens, blues, etc. If bright shades are desired, it is often necessary to sour the goods after scouring, in order to produce as white a ground as possible for the dyes.

Souring, or 'Clearing.'

§122. The object of 'souring' is, as just mentioned, to brighten the colour of the tannage; any iron stains which may be on the leather are also thus removed. Sulphuric acid, on account of its cheapness, is almost universally used for souring. Unfortunately sulphuric acid has a very detrimental effect upon the fibre of the leather, and goods once immersed in even a very dilute solution of the acid, will retain a considerable amount of the acid after prolonged washing in water, the retention of the acid by the leather fibre being so obstinate, that its removal by water is practically impossible (§158). The importance of *not* 'souring,' whenever it is possible to neglect the operation cannot be too strongly impressed upon the leather dresser, particularly when he is dealing with goods that are to be dressed for bookbinding, furniture, and fancy leathers. When commoner grades of goods, for boot uppers, linings, etc., are being dressed, the matter is not of such importance, though even then care should be taken that the goods are well 'sweetened' after the souring.

§123. There is no volatile organic acid that can be substituted for sulphuric acid in souring, none of the volatile organic acids possessing the property of removing iron stains from leather, though both formic and acetic acids will brighten up the colour somewhat. The best available substitute for sulphuric acid is hydrochloric acid. It is much more volatile than sulphuric acid, it will remove iron stains quite as effectually, and it is by no means so injurious to the leather. Moreover, hydrochloric acid

is not taken up with avidity by the leather fibre as sulphuric acid is, and it can therefore be more readily removed from the leather by washing. And removed it must be, for although as stated it is not so hurtful to the leather as sulphuric acid, any excess left in the leather is likely to set up mischief which will show itself later on.

§124. The souring operation is generally performed in a tub. The goods are placed in a solution of sulphuric acid, cold, of about $\frac{3}{4}$ to 1 per cent. strength (by weight, see Appendix) and are stirred round with a piece of wood for from 5 to 10 minutes, until the colour of the leather is perceptibly brightened and any stains removed. If hydrochloric acid is used a 2 per cent. solution is a convenient strength.

§125. With light common goods the clearing or souring operation is sometimes carried out in the drum. The goods whilst still wet from the soaking or scouring are drummed for about 5 minutes in a solution of commercial vitriol, using 1 to 2 ozs. (by weight) of the acid to each gallon of water.

§126. Whether performed in tub or drum the solution should be used cold. A warm solution of vitriol, though more effectual in removing stains, is more detrimental to the leather, the warm solution penetrating into the very heart as it were of the leather from which it is impossible to remove it. In the case of a cold solution the action of the acid is not so intense, unless, indeed, the goods remain in the solution for a long period. It is less detrimental to the goods to give them a very short immersion in a comparatively strong solution of the acid than a long immersion in a weak solution.

§127. After souring, the goods are to be well 'sweetened,' as it is termed, by washing in water. This washing should be thorough, so as to remove as much of the acid remaining in the goods as is possible by treatment with water, and the water should be warm (45° C).

§128. Sumaching.—The sumaching is preferably done in a drum, using a sumach bath at a temperature of about 40° to 50° C. (104° to 122° F). From 3 to 4 lbs. of sumach per dozen calf

skins, with a sufficiency of water, makes a suitable solution. The skins are run in this liquor for from one to two hours, and are washed up in water afterwards to remove any adhering sumach, and struck out on the table with a brass slicker; they are then ready to be dyed. It is customary in some works to sumach straight off after scouring, running the skins for some hours in a strong sumach bath, and following this up by passing them through a weak vitriol sour, making the souring the third operation. In the author's experience however, the plan of souring first after scouring, and then sumaching, gives the best results, and this order of procedure has the further advantage that the sumach bath assists in the removal of the acid left in the skins. That as much acid as possible should be removed from the skins before they are placed in the dyebath is always advisable, especially if the skins are to be dyed with basic dyes.

HIDE BELLIES.

§129. Split hide bellies for shoe purposes are scoured in the same manner as described for shoe-calf. A preliminary scouring on the Burdon Scouring Machine (Fig. 42) before hand-scouring, lessens very considerably the amount of work necessary in the hand-scouring.

§130. After scouring, the goods are sumached for light shades of colour, or are lightly retanned with a suitable tanning extract when medium shades of brown are to be dyed. The retanning with sumach or extract is done either in drum or vat.

§131. When the vat method is adopted, the goods are placed in a warm solution of sumach or extract prepared in a sufficiently large wooden vat; the temperature of the solution when the goods are entered should not be more than 50°C. The goods are handled continuously in the solution for from 10 to 15 minutes, and then left for about an hour, when they are again handled. The goods should be handled several times in this manner in the course of the day and left overnight in the solution.

Drumming Hide Bellies.

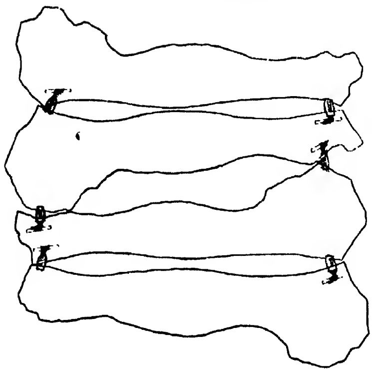


Fig. 51.

§132. If the retanning is done in the drum, the bellies are tied together, end on, as shown in (Fig. 53), and the tying is usually in one long string. The tying assists in preventing the goods from becoming knotted together during the drumming. Still further to prevent such knotting, it is advisable to 'float' the goods in the solution by having the drum well filled with liquor. A better method of tying the bellies is shown in Fig. 51, the bellies being now tied sides together, in fours or sixes. This method of tying practically precludes the possibility of any knotting of the goods. The tying is best effected by using a loop connected to a piece of wood (Fig. 52), simply looping the goods together by passing a loop through two cuts made in the sides of the bellies, and fastening by passing the piece of wood through the loop.

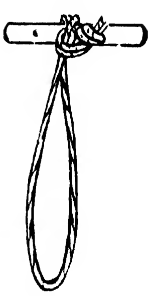


Fig. 52.

East Indian Goat and Sheep, commonly called 'Persians.'

§133. It is the common custom when preparing Persians for the dye bath to remove part of the original tannage; also to free them from grease by drumming in a weak alkaline solution. Common washing soda crystals are usually employed for this purpose, from $1\frac{1}{2}$ to 2 ozs. of the crystals being used per dozen skins. The skins having been drummed in this solution for about a quarter

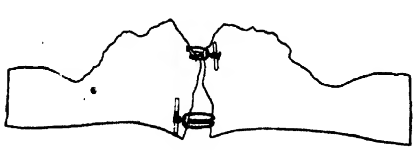


Fig. 53.

of an hour, commencing with the solution at a temperature of 30° C. (86° F.), are taken out, well washed in tepid water, and then passed through a weak vitriol bath. This last operation brightens up the colour of the leather, which has been darkened somewhat by the action of the alkaline bath. The skins are now sweetened from the acid by washing with an abundance of water, and sumached in the drum, using a fairly strong bath, say 1 to 2 lbs. sumach per dozen skins. After sumaching, the skins are washed up in warm water to free them from adhering sumach, and then, after being struck out, they are ready to be dyed.

§134. The alkali not only removes from the skins part of the original tanning agent, but it also removes the greater part of the oil with which these skins are stuffed by the native tanner in order to obtain weight. The oil used by the Indian tanner is generally Sesame oil (Gingelly oil). By the use of this oil the tanner is able to secure a gain in weight of at least 10-15 per cent. on the dry goods, even with the dryest tannages, such as Bombays, Dindiguls, Coimbatores, etc. Many of the greasier tannages contain, in fact, over 30 per cent. of oil. The alkali combines with the grease to form soap, and this is removed by the repeated washing the goods undergo.

§135. The removal of the soap by washing, before the skins are put in the vitriol bath, is extremely important. If the skins were placed in the acid bath before being washed free from soap, the effect would be that the acid would decompose the soap, liberating the fatty acids, which acids are more difficult to deal with than the original grease in the leather, and these fatty acids would be unevenly distributed over the surface of the leather, and uneven dyeing would be the result. Another defect caused by an incomplete removal of the soap before souring, is often observed on dyed and finished skins in the form of a white deposit or 'spue,' which is extremely difficult to get rid of. The author has examined many defectively dyed leathers in which the defects have undoubtedly been caused by insufficient washing after the alkaline bath and before souring.

§136. A better method where the 'stripping' (removal of the grease from) the leather with an alkaline solution is necessary, is to employ a weak borax solution instead of a washing-soda solution. Borax has not the strong solvent action upon the tannin possessed by the strong washing-soda, but it very effectually removes the grease. The colour of the goods is not materially darkened by the process, and the souring may therefore in most cases be omitted. A suitable amount of borax to employ is about 2 ounces per dozen skins. After the stripping, the goods simply require washing up, and they may then be sumached in the usual way.

§137. A weak solution of soft soap acts very efficiently for stripping. The soap should be almost neutral in character. The goods may be drummed in the solution for from 20 to 30 minutes, from 2 to 3 ounces of soap being used per dozen skins. The soap solution removes practically no tannin from the leather, but efficiently clears the grain from all grease. The goods are then simply washed in water and lightly sumached.

§138. As to all these operations it is hardly necessary to remark that the smaller the amount of the original tannage removed from the leather the smaller is the quantity of sumach needed in the sumaching.

§139. In the preparation of goods that are to be dyed of a brown colour, or in medium or dark shades, either cutch or mangrove extract may be substituted with advantage for the sumach, both from the point of view of cheapness, as well as that of resulting 'bottom' colour. These two materials contain not only a large percentage of tannin, but of colouring matter in addition. (See Chapter VI.)

§140. Goods for common class utilisation, such as white back glacés, blue back glacés, linings, top bands, etc., are usually not shaved, the expense of shaving not being permissible on this class of goods. The flesh side is simply fluffed smooth by an emery-covered fluffing wheel. (See Chapter XVI.) Goods to be dressed as brown glacés, moroccos, etc., are usually necked, either on the machine or by hand.

§141. In the dressing of Persians of common class, where cost is of very primary consideration, the operations both of stripping, souring, and sumaching, may be omitted. The goods after being damped down and shaved, or fluffed as above explained, are placed in the drum with a small quantity of water, and 'scoured' (see §119), for about an hour by attrition against each other. After removal from the drum the skins are simply washed in water, struck out, and dyed. It is nevertheless advisable, whenever possible, to lightly sumach the goods after the drum scouring.

Preparation of Basils.

§142. Australian Basils.—These goods, which are tanned usually with Mimosa Bark, are generally of very inferior quality, as compared with English or Scotch Basils, and are therefore for the most part made use of for shoe linings, top bands, and common fancy purposes. A few of the better quality skins are dressed for cheap boot uppers, bookbinding, etc.

§143. The preparation of these skins is to a large extent confined to a light stripping, with a weak solution of either borax or washing soda, and afterwards washing, and souring with vitriol when light shades are to be dyed, the souring being omitted when dark shades are intended. Finally the goods are given a light sumaching.

§144. New Zealand Basils.—These are generally of better quality than Australian Basils, and they usually require nothing in the way of preparation beyond a drumming in a weak sumach infusion.

§145. The preparation of New Zealand and Australian Basils when they undergo preparation, is very similar to that of Persians. Either of the methods mentioned above (§133 and §136), may be employed upon these goods.

§146. Turkish and Smyrna Basils.—These are tanned with a species of sumach and are the commonest kind of skins imported into this country. They are badly flayed, badly fleshed, and usually only half tanned. In preparing these goods, which are only fit for boot linings, they

are best retanned, after scouring in the drum, with sumach if required a light colour, or with quebracho extract or other cheap tanning extract, if a medium shade of colour is not objectionable.

§147. When retanned, the goods are washed, and then, if necessary, soured with vitriol or hydrochloric acid. After striking out on the flesh side, they are ready for dyeing. If the skins are stout, they should be dried out after the preparation, and fluffed or shaved on the flesh side.

SUMACH TANNAGES.

§148. SKIVERS.—These are generally soaked down in water, soured in the manner described above, and afterwards sweetened; they are then ready for the dyebath.

§149. In many cases, especially when such comparatively dark colours as ledger reds, myrtles, olives, sages, browns, etc., are to be dyed, and the goods are free from stains, the souring operations may with advantage be entirely omitted; the goods being simply soaked and drummed for about half-an-hour in warm water, horsed up, and then transferred to the dye-bath.

§150. Stale goods, which do not take colour readily, should be paddled or floated in the drum for about an hour before dyeing, in a weak sumach infusion. If this is not effectual in securing level dyeing, owing to the goods being very old, they should be treated with a weak borax solution before sumaching.

§151. When applying basic colours, it is advisable, previous to dyeing, to fix in an insoluble form any excess of tanning matter in the leather, by treatment with a weak solution of Antimony Potassium Tartrate (Tartar Emetic), Antimony Lactate, or a salt of Titanium.

Details as to the method of application of these salts, etc., will be found in Chapter V.

§152. GOAT, SHEEP, AND CALF.—Sumach tanned goat, sheep, and calf, if delivered to the dyer in a crust state, and not kept in stock too long, simply require a thorough soaking to wet them

back; they are then, after samming and shaving, ready for the dye-bath. When dealing with skins that are to be finished for upholstery leathers, the shaving is done after the dyeing. If the skins have been kept in stock for any length of time, it will be found that they do not take the dye uniformly, but are apt to dye somewhat uneven. If this comes about, it is better to slightly re-sumach the skins in the drum, in the same manner as described for bark-tanned calf; the goods will then be found to take the dye quite readily.

§153. Before leaving the subject of the preparation of sumach tanned leathers, it may not be out of place to make a few remarks regarding the method of preparation of these goods, so as to conform with the specification laid down by the Society of Arts Committee on "Leather for Bookbinding," as contained in the Report of the Committee issued in 1901, a more complete edition of which was issued in 1905.

§154. With regard to shaving, the recommendations of the Committee are that this operation,—"if done at all, should only be to a limited extent, since, however it may be carried out, it necessarily weakens the skin by removing its toughest parts, and therefore, for small books, thin skins should be chosen, so as to avoid the necessity of paring down, while for larger ones a larger and stouter skin may be used. Librarians and bookbinders must realise that they cannot have a large thin skin which will last, since the thin substance can only be secured by shaving (or splitting, which is still more weakening). If this rule is followed then the shaving is reduced to simply 'necking' and 'backing,' to equalise the thickness of different parts, and to remove loose adhering flesh."

§155. In respect of souring, the Report of the Committee states that "the use of any but mild organic acids in souring or scouring the leather, or in the dye-bath must be absolutely condemned."

§156. And further, the Report states—"It has been shown by careful experiment, that even a minute quantity of sulphuric

acid is at once absorbed by the leather, and that no amount of subsequent washing will remove it. In a very large proportion of cases the decay of modern sumach-tanned leather has been due to the sulphuric acid used." *(See* §122*).*

§157. The Report condemns also "the use of strong alkalies or alkaline salts like soda."

§158. The conditions of the Society of Arts Committee in respect of the manufacture of leather for bookbinding, summarised, are these:—

> (1) In preparing the leather for dyeing, the goods, after lightly shaving to remove superfluous flesh adhering to the flesh side, and levelling down at the neck and back, should be simply well soaked, re-sumached if necessary, and struck out.
>
> (2) In the preparation for dyeing, the souring operation must be entirely omitted.
>
> The omission is imperative,—for the reason that sulphuric or hydrochloric acid may on no account be used, and that practically there is no other organic acid of any value in removing stains from leather and rendering it white to the degree that is obtainable by the employment of these acids; with the exception of oxalic acid, which is as injurious as sulphuric acid.

§159. This necessitates careful selection of the goods according to the particular colours they are to be dyed. Stained skins can only be utilised for bookbinding leathers when very dark shades are required; clean white skins must be chosen if the dyeing is to be in bright pale shades.

To face page 65.

Dye House (Sheep Leather).

CHAPTER II.

BLEACHING.

§160. When very brilliant or pale shades of colour are to be produced on leather it is generally necessary that the goods should first of all be 'bleached,' that is to say, be freed from colour; in other words, be as far as possible 'whitened.'

§161. Very few of the methods of bleaching textiles can be satisfactorily applied to the bleaching of leather, and by no known method of bleaching can a perfectly white vegetable-tanned leather be produced. The only practical method of obtaining a vegetable tanned leather that can be called white, is that called 'lead bleaching,' dealt with below (§187), a method which is really one of pigment dyeing.

§162. The ancient method of bleaching was by exposure of the material dealt with to the action of the sun. This method is limited in its application to vegetable-tanned leather because of the tendency of many tannages to darken instead of whiten on exposure to sunlight. The method is, however, still practised when chamois and alumed leathers are under treatment.

§163. This natural bleaching, as it may be called, is carried out by spreading the skins to be bleached upon either a sheet of canvas tightly stretched, and supported some two or three feet away from the ground, or by simply laying the skins upon the grass (hence the term 'grass bleaching.') A southern aspect, so that the goods may get as much sun as possible, is of course

desirable, and a neighbourhood in which dust and dirt do not abound, is a necessity. When chamois and oil-dressed leathers are under treatment it is customary to pass the goods through an oil and soap emulsion, lightly wring them out, and expose them in their damp condition. Alum-dressed leathers are usually exposed dry. The exposure is for several days, until the goods are sufficiently white for the purpose intended. The goods are brought in under cover at night time.

§164. 'SULPHUR BLEACHING.'—In this process of bleaching, the leather is exposed to the action of sulphur fumes (sulphur-dioxide gas). The method is more applicable to the bleaching of chamois leathers and wool skins than to the bleaching of vegetable-tanned leathers, and the 'stoving' as it is called, is carried out usually in the following manner.

§165. The goods, which are preferably in a damp condition, are hung over poles fixed horizontally, or are nailed on wooden boards or frames, in a room ('stove') constructed specially for such bleaching. After arranging the goods so that no two skins touch each other, a vessel, preferably a shallow cast-iron pan, containing powdered sulphur which has been moistened with methylated spirit and ignited by a match, is introduced into the room. The door is then closed, and the goods remain undisturbed for about twelve hours. The door is then opened, and the sulphur fumes are allowed to escape. After a bleaching, it is most important that the room should be well ventilated before any person enters it, for the danger otherwise of being overcome by the fumes is a real danger. If this exposure has not sufficiently bleached the goods, a further supply of ignited sulphur should be placed in the room, the door again closed, and the goods left for a further period of twelve hours.

§166. An alternative method of sulphur bleaching is that termed the 'liquid sulphur' bleach. The goods are treated by this method in a solution of sulphurous acid.

§167. Sulphurous acid is made by burning sulphur in a suitable stove, and passing the sulphur-dioxide gas which is given

off, through a 'scrubber' packed with broken earthenware, coke or similar material. A stream of water is allowed to trickle through the scrubber and the gas is absorbed.*

§168. Sulphur-dioxide gas can now be purchased in liquid form, being liquified under pressure; it is supplied in strong copper cylinder or drum. And the sulphurous-acid solution may be made by connecting the cylinder or drum to the vessel containing the water for the bath and charging the water with the gas. The charging is effected with very little trouble.

§169. Or, the liquid-sulphur bleach may be carried out by first treating the goods with a solution of bi-sulphite of soda, and afterwards in a weak solution of hydrochloric or sulphuric acid.

§170. Or by treating the goods direct in an acidulated solution of bi-sulphite of soda. The bath can be easily prepared by diluting 5lbs. of liquid bisulphite of soda or potash in 20 gallons of water, and adding gradually from 1lb. to 2lbs. of commercial hydrochloric acid, which has been diluted by the addition of an equal volume of water. The skins to be bleached are as quickly as possible placed in this bath, and they remain in it until bleached throughout; the duration of the immersion cannot be fixed in any other way. A little further acid may be added to the bath, if judged to be necessary, as the bleaching proceeds. The process is conveniently carried out in a wooden tub, or in a covered paddle, or drum. When the skins are sufficiently bleached they should be removed from the bath and well washed in clean water at a temperature of from 35° to 40° C. (95° to 104° F.).

§171. Bi-sulphite of soda, in liquid form, contains from 16 to 18 per cent. of sulphur-dioxide combined with the soda, hence its employment as just described. The addition of the hydrochloric or sulphuric acid to the bi-sulphite solution liberates the sulphur-dioxide gas.

§172. Sulphur bleaching, however, whether by 'stoving' or by solution, affords anything but satisfactory results. The 'white'

* See Procter's *Principles of Leather Manufacture*, 1903, pp. 23-25

obtained is not white, and the leather becomes impregnated with sulphurous acid, which, eventually oxidising to sulphuric acid, is seriously detrimental to the leather fibre (see §156 above). For wool skins, however (§164), the method is still universally employed, notwithstanding that there is a lack of permanence in the white produced, that an objectionable smell is imparted to the wool, and that the retention of the sulphurous acid in the fibre gives the wool a somewhat harsh feel, and causes the subsequent dyeing to be liable to be uneven. The last objection does not apply however if the goods, as is customary, are passed through a solution of bleaching powder, the sulphurous acid being destroyed by this treatment. The counterbalancing advantage to the disadvantages of the method is its commercial advantage of being inexpensive. For wool skins the more modern method of bleaching with sodium peroxide (§177), is greatly superior, but rather more expensive.

§173. Bleaching with Hypochlorites.—Hypochlorites have a limited application in leather bleaching, because of the yellow colour which they impart to the leather. They are serviceable however for the bleaching of wool skins, and in the bleaching of chamois leather. The first bleaching hypochlorite manufactured was 'Eau de Javelle,' in 1792, a compound of potassium bicarbonate and hypochlorous acid, prepared by passing chlorine into a strong solution of potassium carbonate. 'Eau de Labarraque,' another bleaching compound, placed on the market in 1820, is a solution of sodium hypochlorite, and is prepared by passing chlorine into a cold solution of caustic soda. It is now being manufactured electrolytically.

§174. In the bleaching of leather with sodium hypochlorite, the goods are immersed in a very dilute solution and afterwards passed through a weak vitriol sour. In the 'chloring' of wool mats and furs, this hypochlorite is preferable to bleaching powder both economically and otherwise.

§175. Bleaching with Peroxides.—For their bleaching property the peroxides, used in weak alkaline solution, depend upon the liberation of the nascent oxygen; the liberated oxygen

possessing greater affinity for colouring matters in the goods than for the leather fibre. It can consequently be employed without danger of injuring the goods.

§176. Hydrogen Peroxide.—This is a peroxide that has been recommended for leather bleaching, but it is of little or no value with vegetable-tanned leathers. It certainly has bleaching powers, however, when used upon oil dressed (chamois and buff leather) or aldehyde leathers. Its disadvantages are that it is expensive, and that it does not keep well; being sold in the form of a solution it gradually decomposes in storage.

§177. Sodium Peroxide.—This peroxide, which is now somewhat extensively employed in the bleaching of textiles, possesses advantages over the hydrogen peroxide in that it is cheaper, and keeps longer. To prepare the bleaching liquor, the salt may first be dissolved in water, and sulphuric acid be then added until the caustic soda formed in the solution has been neutralised, and the resulting liquor is simply a solution of sodium sulphate, and hydrogen peroxide.

§178. The method to be recommended, however, of making the bleaching liquor, is to first dilute 2lbs. of concentrated vitriol with about 20 gallons of water, and then to add the sodium peroxide, sprinkling the solid salt into the solution and constantly stirring, the addition of the sodium peroxide being continued until the vitriol is neutralised, which may be ascertained by testing with a piece of red litmus paper. The liquor should be used immediately after preparation, and the goods to be bleached should be immersed for several hours. When chamois leathers or wool skins are being treated, it is advisable to have the liquor faintly alkaline, making it so by the addition of a small quantity of sodium silicate. The bleach obtained by sodium peroxide is much more durable than the bleach by the sulphur method, and approaches much more nearly to the sun bleach. For wool skins the method is of the greatest utility; its cost, however, is at present against its general adoption for that bleaching. Where possible, wool skins which have been sulphur bleached and are intended to be dressed white, should be treated afterwards to a weakly alkaline solution

of hydrogen peroxide. Not only is a purer white obtained by this procedure, but the sulphurous acid retained in the fibres is neutralised.

§179. PERMANGANATE BLEACH.—This is a bleach that is particularly applicable to chamois or wash-leather. It is also of limited application to vegetable-tanned leather. The usefulness of the method comes of the strong oxidising action of the potassium permanganate that is employed. When chamois and oil leathers are to be treated the bleaching is carried out as follows:—

§180. First of all the skins must be cleansed of grease. This cleansing must be carefully attended to. Unless all grease is removed, it is quite impossible to obtain a thoroughly uniform and level bleach.

§181. The excess of grease and of oxidised oil in chamois leather may be readily removed by soaking the skins in a from ½ to 1 per cent. solution of soda crystals at a temperature of about 30°C., or in a solution of from 3 to 4 ozs. of soap per gallon of water. The skins should be drummed in the solution for about half-an-hour, or constantly stirred in a large tub of water for about an hour. They should be then washed in plenty of warm water, at about 35 to 40° C., until free from soap or soda. When soda is used great care must be taken that the strength of the solution does not exceed 1 per cent. The action of a strong solution on the fibres of the leather is to make them tender. A 3 per cent. soda solution will entirely destroy the goods.

§182. After thoroughly washing, the skins are placed in a bath, made by dissolving 2 ozs. of potassium permanganate in 10 gallons of water, to which ½ oz. of sulphuric acid has been added. The addition of the acid is advisable because slightly alkaline permanganate solutions rapidly disintegrate the leather fibre. The commercial potassium permanganate answers all purposes. The skins are kept in this solution for about an hour, beginning at a temperature of about 35° C.; the operation is best performed in a large wooden tub.

§183. When the leathers are of a nice level brown colour, due to the reduction of the permanganate and the consequent deposition of manganese dioxide on the fibre, they are removed from the bath, rinsed in clean water, and placed in a bath of sulphurous acid, which rapidly removes the manganese dioxide. The preparation of the sulphurous acid solution has been already (§§168, 170) explained. On the completion of the bleach, the goods are taken from the bath and well washed in clean water at a temperature of from 35° to 40 C°.

§184. A solution of hydrosulphite (§205) or an acidified solution of hydrogen peroxide (§176) may be substituted for the sulphurous acid.

§185. When vegetable-tanned leather is treated, a much weaker solution of the permanganate should be employed, a solution, say of ¼lb. of permanganate to 150 gallons of water. If other than a very weak solution is used, there is liability of permanent damage to the leather.

§186. If carefully carried out the permanganate bleach is of great service with dark-coloured tannages, such as hemlock, mangrove, etc., in brightening up the leather, altering this from a somewhat dark red colour to a paler yellowish shade. The method is moreover quick and not very expensive.

§187. The 'Lead' Bleach.—The term 'lead-bleach' is a misnomer. The colour of goods lead-bleached is not destroyed, but the whiteness of the goods is produced by the deposition of lead sulphate on the surface of the leather, so that the process is not one of bleaching, but, as before stated (§161), of pigment dyeing. It is not necessary to sour skins before bleaching with lead, but it is advisable to give them a sumach bath, particularly if they are not sumach-tanned skins. The impregnation of the goods with small particles of solid sumach helps very materially in the deposition of the lead sulphate; the white pigment being deposited on the small particles of sumach as well as on the surface and fibre of the leather.

§188. After sumaching and lightly rinsing the skins that are to be lead bleached, they are thrown into a soft water and run for about an hour in a solution of sugar of lead (lead acetate), of from ½ to 1 per cent. strength. They are then transferred, without washing, to a vitriol bath of about ½ per cent. strength, and kept in motion until they have acquired the necessary degree of whiteness. The operation may be repeated if a high degree of whiteness is required—the baths being respectively strengthened by the addition of sugar of lead and vitriol. The goods should now be thoroughly 'sweetened' by washing in several changes of water. When 'Persians', basils, and bark calf are being treated, the lead-acetate solution is best applied in the drum. Skivers are best treated in the paddle with both the solutions.

§189. In the preparation of the lead-acetate bath, the addition of a small quantity of acetic acid helps materially in getting the salt into solution and preventing precipitation.

§190. If the goods when 'bleached' have an objectionable yellow tint, this means that either the lead-acetate solution has not been sufficiently strong, or the vitriol solution. Test may be made of which solution is at fault by placing a cutting from one of the skins in a rather more concentrated solution of the acid. If the colour now becomes white it is clear that the original vitriol solution was too weak and must therefore be strengthened. On the other hand, if the colour remains unaltered, it is the lead-acetate bath that has been insufficiently strong.

§191. The lead-bleach is usually employed in the bleaching of skivers and calf for hat leathers that are to be finished white or cream, etc. As, however, the process is not costly it may be advantageously made use of with Persians, etc., which are to be dyed in many of the very pale shades now fashionable for linings and top bands of boots.

§192. The solution of lead acetate to be recommended when 10 dozen skivers are to be treated is of 30 lbs. of the acetate to 300 gallons of water, and the goods are to be transferred to a vitriol solution of 12 lbs. of vitriol in 300 gallons of water. The goods are

paddled (see Fig. 54) in the lead bath for about 20 minutes, until, by the lead tannate, which is formed by the action of the lead on the tannin in the leather, they are coloured a comparatively deep shade of greenish yellow. They are then placed in the vitriol bath, which should be in close proximity to the lead bath, and are kept in motion until they are white.

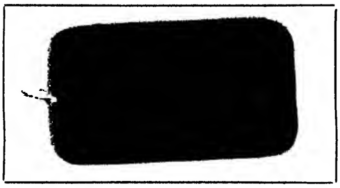
§193. The above solutions may be used for a second pack of 10 dozen goods if respectively strengthened up with 15 lbs. acetate and 6 lbs. vitriol. And with the necessary additions of acetate and vitriol for each pack the baths may be used for three or four packs in succession. It is not advisable, however, to use either of the baths more than four times, as the solutions become charged with pieces of loose fibre, sumach, etc., to such an extent, that with further use there is a liability of the goods becoming stained.

Fig. 54.

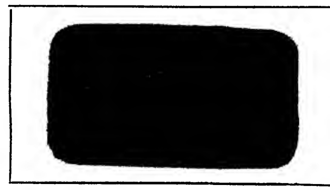
§194. Where the difference in price of the white and brown sugar of lead is not great, it is generally advisable to employ the purer article—the white (or grey) lead acetate. The brown salt having been manufactured with crude acetic acid (Pyroligneous acid), contains a quantity of objectionable brown colouring matter, which, in the writer's experience, has caused stains to become visible on the finished leather.

§195. Patterns of leather showing the colour before bleaching and the colour after bleaching are shown below. There are

many objections to the lead bleach; but up to the present time, no method of whitening leather has been devised which gives such satisfactory result. And the bleach is cheap.



Pattern of Sumach Tanned Skiver.



Pattern of Sumach Tanned Skiver after 'Lead Bleaching.'

§196. One great objection to the lead bleach is that it is injurious to the health of the worker. Another objection is that leather so bleached has the serious disadvantage of darkening by exposure to the air, unless covered with an air-proof finish. This darkening is owing to the fact that air, especially the air of towns, contains sulphur vapours produced by the combustion of gas and coal; which vapours combine with the lead sulphate to produce lead sulphide, which is a black salt.

Machine Bleaching.

§197. Fig. 55 is a diagram view explanatory of a machine that has been recently introduced for leather-bleaching which may be employed with advantage when heavy goods are to be passed through successive baths of, say, borax, and hydrochloric acid to improve the colour of the tannage, or through potassium permanganate and sulphurous acid (§183).

§198. An endless chain *a, a,* passes over sprocket wheels, (wheels furnished with teeth to engage the links of a chain), *b, b,* which are mounted on the inside of a vertical wooden framing. Correspondingly on the inside of another vertical wooden framing which is fixed opposite to the first-named framing is a second endless chain passing over sprocket wheels similarly mounted. Between these two framings, longitudinally, a series of vats, 1, 2, 3, 4 are placed. Upon rods going horizontally across from chain to chain at equal distances apart, and pivoted in the chains, carriers are

swung, each of the carriers capable of holding several of the butts or skins to be bleached. By guideways suitably placed upon the wooden framing the endless chains are compelled to go

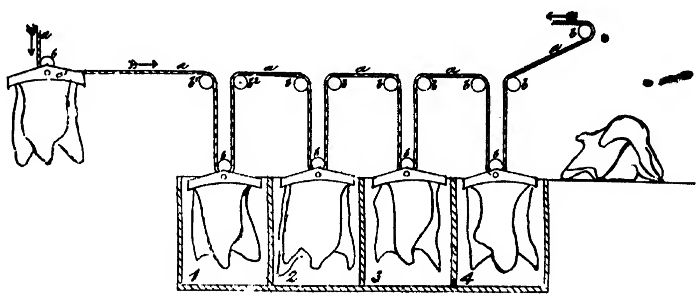


Fig. 55.

always through the same fixed travel. The course of the hains is shown by the arrows; the front of the machine is to the eft, and there also is the lever by which the power that drives the nachine is under the control of the operator.

§199. Let us go through a bleach. When the working comnences, the carriers are all empty. The operator first loads the arrier c^1 with its full complement of butts or skins, say it will arry 6, and he then by means of the lever starts the endless hains. These moving as shown by the arrows, carry c^1 to the procket wheel b^1, and then carry it downwards until the skins are mmersed in the liquor that is in vat 1. Now the chains stop, utomatically, and the operator loads a second carrier, which, vhilst c^1 was moving into the vat from its position of rest, was on ts road to the loading position. Having loaded the second arrier he again starts the chains, and the carrier c^1 rises to the procket wheel b^2. Here the worker leaves it awhile, for the kins to drain off, occupying himself meantime with something lse. This movement of the chains that lifted the carrier c^1, has noved the second carrier onwards towards the vat 1. The draining-off completed, the operator once more starts the chains, nd c^1 with its skins is carried into vat 2, and there left by the

automatic stoppage of the chains. The skins always maintain their vertical position, because the carrier rods, being as stated pivoted in the chains, are swing rods, and the weight of the skins swings them as required. The skins of carrier c^1 are now in vat 2, and the movement of the chains which took them into vat 2 has taken the skins of the second carrier into vat 1. But that same movement has brought a third carrier into the loading position, and the operator loads it while the skins are soaking in vats 1 & 2. Again starting the chains, the skins in vats 1 and 2 are lifted out of their liquors and left as lifted to drain. A further movement of the chains takes the first carrier c^1 into vat 3, the second carrier into vat 2, and the carrier just loaded into vat 1, and there they are left by the automatic stoppage of the chains. The same movement has brought a fourth carrier into the loading position, which the operator loads, and then, starting the chains, moves it onward towards vat 1, the skins of the second, third, and fourth carriers meanwhile draining-off. Another move of the chains takes the first carrier c^1 into vat 4, and the second, third, and fourth carriers with their skins into respectively vats 3, 2, and 1, and brings another carrier into position ready for loading. Next comes a move of the chains which takes all the carriers into the position for draining-off, and then a final move which takes the last-loaded carrier into vat 1 and at the same time automatically throws off the skins from carrier c^1 on to a table at the back of the machine, as seen in the Fig. The carriers, pivoted in the chains, move on with the chains to a higher level after discharging their loads and are taken back to the front end of the machine, each carrier, in turn, coming to the loading position.

§200. This particular machine that we are dealing with is fitted with 4 vats only, but of course there may be any number of vats, with carriers and details to correspond. Here vat 1 would have, say, an alkaline liquor, vat 2 an acid liquor, and vats 3 and 4 would have water to wash the skins after their going through the liquors of vats 1 and 2.

CHAPTER III.

'STRIPPING AGENTS.'

§201. To 'strip' dyed leathers is to remove the colouring matter that is in them, so that the goods may be re-dyed.

§202. It sometimes happens that the dyeing of a pack of goods has been irregular, and that it is consequently requisite to remove the colour from them. Or the dyeing has not been exactly to pattern. Or it is desired to dye to one uniform shade of colour a number of skins that are of different colours.

§203. Accidents will happen in the best regulated (dye) houses, and in the event of a mistake on the part of the dyer, who, like other mortals, is not infallible, it is a relief to him that the case is not past remedy, and that it is possible to 'strip' from the goods that have gone amiss the colouring matter of their first dyeing and to almost completely decolorise them, so that the dyeing process may be repeated.

§204. STRIPPING WITH WEAK ALKALIES. — The common method of stripping colour from leather, that universally practised up to the present, is to tumble the goods in drum or paddle, in a weak solution of washing soda, soft soap, borax or other weak alkaline solution, going through, in fact, the operations described in §§133-136, above. This procedure has the effect of removing quite a considerable amount of colour from most dyed leathers, and when followed by treating the goods to a warm (45° C.) sumach infusion in the drum, still more of the colouring matter is removed, particularly if an 'acid' colour has been employed in the original dyeing of the leathers. And the method is in many cases sufficiently effective to allow of the re-dyeing of the leathers in dark shades.

4 to 5 per cent. solution for basic colours), or a cold weak solution of ammonia, (a solution of from ¼ to ½ per cent., for acid colours), in order to obtain the pale ground requisite for a re-dyeing. When the leather has been fixed by treatment with antimony or titanium salts (Chapter V.) the mordant should be removed before stripping by treatment with a weak solution of hydrochloric acid.

§214. Owing to the unstable nature of the sodium hydrosulphite (§§207, 209) when dissolved in water, it is advisable to first place the goods to be stripped in a sufficient quantity of water, and to add the hydrosulphite immediately after preparing the solution of the salts. A solution of sodium hydrosulphite rapidly loses its stripping properties, on being kept even for so short a period as 15 minutes, owing to its absorbing oxygen from the air and thereby becoming converted into sodium bisulphite. Even when not exposed to air it decomposes, forming sodium thiosulphate. The solution should therefore only be prepared, as stated, when actually required for use.

§215. In the majority of cases a preliminary treatment is not necessary, especially if the goods are to be sumached before a re-dyeing.

§216. A table showing the behaviour of leather dyed with the more common basic and acid dyestuffs, and afterwards subjected to stripping, with the particular procedure employed, is given on pages 81, 82, & 83.

§217. It will be seen in one or two cases, notably with Safranines, Magentas, and Methyl Violets, that though the treatment with hydrosulphite strips the colour, the colour returns on subsequent exposure to the air. For these colours, therefore, 'stripping' with hydrosulphite is to no purpose.

Leather Dyed.	Treated first with	Result of Treatment	Treated Secondly with	Final Result.
Diamine Brown 3G.,(C.) ... (dyed with salt in the bath)	5% solution of Acetic Acid at 45° C and washed	No colour removed ...	10% solution of Hydrosulphite at 45°C. ...	Colour completely removed.
Victoria Blue 3314, (B.S. & S.)	,,	,,	,,	Strips to a light grey.
Methyl Violet 4B., (Ber.) ...	,,	Little, if any, colour removed	,,	Little, if any, colour removed.
Bismark Brown 12196, (Ber.)	,,	Much colour removed ...	,,	Colour completely removed
Magenta 4138, (B. S. & S.)	,,	,,	,,	Strips to pale pink.
Neutral Violet Extra, (C.) ...	,,	,,	,,	Strips to pale pink.
Safranine G. Extra, (Ber.) ...	,,	,,	,,	Strips but colour returns quickly on exposure to air.
Safranine Scarlet G., (B.) ...	,,	,,	,,	Strips but colour returns slowly on exposure to air
Acid Brown R., (R. H. & S.)	A cold 1% solution of Ammonia and washed	Little colour removed ...	,,	Colour completely removed.
Napthylamine Black 4B.,(C.)	,,	,,	,,	Colour completely removed.
Guinea Green G., (Ber.) ...	,,	,,	,,	Strips to a pale green
Cyanole Extra, (C.)	,,	,,	,,	Strips to pale blue.
Erioglaucine, (G.)	,,	,,	,,	Strips to pale blue.
Fast Red A., (By.) ...	,,	Much colour removed ...	,,	Colour completely removed
Cochineal Scarlet R.S., (By.)	,,	,,	,,	,,
Napthol Green B., (C.) ...	,,	,,	,,	,,
Resorcine Brown, (Dahl.) ...	,,	,,	,,	,,
Palatine Scarlet R., (B.) ...	,,	,,	,,	,,
Napthylamine Brown, (B.)...	,,	,,	,,	,,
Lanacyl Navy Blue B.,(C.)...	,,	,,	,,	,,
Tartrazine, (B.)	,,	,,	,,	,,

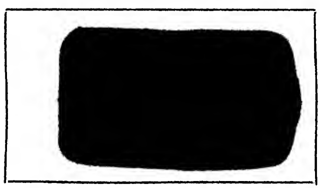
Leather Dyed.	*Treated first with*	*Result of Treatment.*	*Treated Secondly with*	*Final Result.*
Orange G, (R H. & S.) ...	A cold 1% solution of Ammonium Hydrate and washed	Much colour removed ...	10% solution of Hydrosulphite at 45°C. ...	Colour completely removed.
Fast Brown, (By.)	„	„	„	„
Acid Violet F., (R. H. & S.)	„	„	„	Strips to a pale violet on prolonged treatment.
Quinoline Yellow, (By.) ...	„	„	„	No further stripping takes place
Bismark Brown, (Ber.) (fixed)	A cold 1% solution of Hydrochloric Acid ...	Little Colour removed ...	„	Colour Strips slowly.
Chrysoidine Crys. (W.) ...	„	„	„	„
Quinoline Yellow, (Ber.) ...	Treated with a 10% solution of Hydrosulphite at 45° C	Little, if any, colour removed	NO AFTER TREATMENT	
Cyanole Extra, (C.)	„	„		
Erioglaucine, (G.)	„	„		
Auramine II, (Ber.) (fixed)...	„	„		
Chrysoidine Diamond Crystals, (W.) (fixed) ...	„	„		
Bismark Brown 12196, (Ber.) (fixed)	„	„		
Potassium Titanium Oxalate,	„	„		
Fast Red A.V., (B.)	„	„		
Fast Red x1528, (By.)	„	Colour completely removed		
Cardinal Red J., (R H. & S.)	„	„		
Bordeaux Extra, (Ber.) ...	„	„		
Azo Flavine R.S., (B.) ...	„	„		
Azo Flavine 2R., (B.) ...	„	„		
Napthol Yellow S, (By.) ...	„	„		
Orange II, (B.)	„	„		

Leather Dyed.	Treated first with	Result of Treatment.	Treated Secondly with	Final Result.
Acid Anthracene Brown R (By.)	Treated with a 10% solution of Hydrosulphite at 45° C	Colour completely removed	NO AFTER TREATMENT.	
Fast Scarlet B., (B.)	,,	,,		
Dark Nut Brown, (Uer.) ...	,,	,,		
Bavarian Blue D.B., (Ber.)...	,,	,,		
Fast Brown N., (B.)	,,	,,		
Chrysoidine (W.)	,,	,,		
Napthylamine Brown, (B.)...	,,	,,		
Acid Brown, (Uer.)	,,	,,		
New Golden Brown A1., (C.)	,,	,,		
Acid Brown L., (B.)	,,	,,		
Mandarine G Extra, (Ber.)	,,	,,		
Azo Fuchsine B., (By.) ...	,,	,,		
Indian Yellow R., (By.) ...	,,	,,		
Napthylamine Black 4B., (C.)	,,	,,		
Water Blue 3 B., (Ber.) ...	,,	,,		
Logwood, ...	,,	,,		
Logwood and Iron, ...	,,	,,		
Ponceau, (Ber.)	,,	,,		
Nigrosine L.I., (By.) ...	,,	Colour completely removed but returns to a light grey on exposure to air		
Induline B.E., (S.A.D.M.C.)	,,	,,		
Guinea Green B., (Ber.) ...	,,	Strips to a pale green ...		
Light Green S F blue shade, (B.)	,,	,,		
Acid Green G.G. Extra, (By.)	,,	,,		
Acid Violet 3 B N., (B.) ...	,,	Strips to pale violet, but colour returns on exposure to air		

LEATHER DYED WITH

Ponceau 3 R.B. (Ber.)

As Dyed.

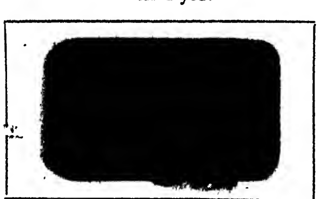


After treatment with Hydrosulphite.

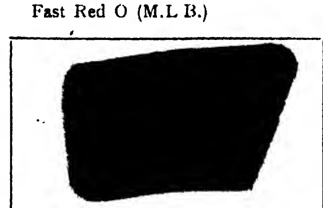
LEATHER DYED WITH

Lanacyl Navy Blue B. (C.)

As Dyed.



After treatment with Hydrosulphite
and re-dyeing with —
Fast Red O (M.L B.)



To face page 85.

Tray Dyeing in 1850 (Messrs. Bevingtons & Sons.)

CHAPTER IV.

METHODS OF DYEING.

§218. THE DIP METHOD.—The oldest method of dyeing leather, one which is still largely practised, especially on the continent, is a simple dipping of the goods to be dyed in a shallow wooden box or trough containing the dye solution. This method is known as the 'box' or 'dip' method. The size of the box is commonly about 3ft. 6in. long by 12 inches wide by 9 to 10 inches deep.

§219. The skins to be dyed, after being struck out, are 'paired,' that is, joined in couples. This pairing is done by taking two skins of as nearly equal size as possible, placing them carefully together flesh side to flesh side, and then making them stick one to the other by first of all slicking (§107) over the grain side of the top skin as the pair of skins lies on the table, turning the skins over afterwards on the table, and then slicking over the grain side of the skin, now at top, that was at the bottom. The skins, after pairing up, are ready for dipping in the dye-bath. One pair of skins at a time are dyed. The worker, usually a boy, takes hold of the pair by the hind shanks, and transfers them to the dye-bath, being careful that the two skins do not come apart. Then, keeping the skins extended, he dips them in and out of the dye-bath, and carries them backwards and forwards through the bath, the lengthways of it or the crossways of it, as he finds most convenient, until the fulness of shade required is attained. When one pair of skins has been dyed, the bath is run off, a fresh bath prepared, and another pair of skins are treated in the same way.

§220. In this 'dip' method, the box or tray is often used tilted up on end, or a tray is made such as shown in section in Fig. 56, which, being double, allows of two men working at the one tray; a bath being prepared in each of the hollows.

§221. This dip or tray method of dyeing is laborious, and only suitable in the dyeing of special goods; for example, skivers for hat leathers, where it is often imperative that the goods should possess a clean undyed flesh. The bath, in quantity, is just sufficient to permit of the goods being easily dipped below its surface; the usual quantity is 2 to 3 gallons about. A stock solution of the required dye is prepared, about 8 ozs. of the dye being dissolved in each gallon of water, and a certain measured quantity of this solution is put into the bath, which is at a temperature of 50° C.; if skivers are to be treated about 1 pint, and about $1\frac{1}{2}$ pints if the goods are calf skins.

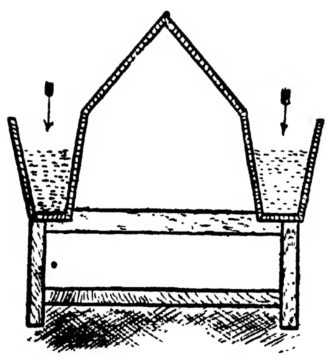


Fig. 56.

§222. The average time for a 'dip' is about five minutes. With the dip method it is customary to use the basic colours (see §301), as these dye more rapidly than the acid dyestuffs.

§223. The dip method is crude, embryonic, and slow, costly in labour and in material. In practice it is mostly impossible to exhaust the dye from the bath in the time that can be given to the dyeing, the consequence being that there is much waste of dye, and that much stronger solutions have to be employed in order to get a sufficient depth of shade than if the goods could be allowed to remain for a longer period in the bath. The method may be regarded as a makeshift, to be employed when no other method is readily available.

§224. The Tray Method of Dyeing.—The dip method of dyeing has been condemned in the last paragraph, and yet the 'tray' method is at bottom the same as the dip method. The manipulation, however, makes every difference. The method is ancient, but still, to a very large extent, employed to-day. The illustration facing p. 85, shows tray-dyeing at Messrs. Bevington's factory, Bermondsey, prior to 1851, and the method as there shown, is that still employed in many parts of the country.

§225. As in the dip method, the skins to be dyed are usually paired together flesh to flesh, thus economising dyestuff and to a considerable extent keeping the flesh side not dyed. Whenever it is possible to pair the goods overnight it is advantageous to do so, and to leave the paired skins in pile over a horse. Skins thus paired and left, adhere better to each other during the dyeing operation. If not thus treated there is a tendency for them to come apart in the 'turning.'

§226. A dyeing tray is seen in the illustration facing p. 85. It is a shallow rectangular vessel, usually of wood, 4ft. 6in. long about, by about 3ft. 6in. wide, and about 9 to 10 inches deep, when sumach goats, roans, medium-size skivers, etc., are being worked. The size of tray suitable for dyeing calf, large skivers, etc., is 5ft. 6in. long, 4ft. wide, 12 inches deep.

§227. The pack of goods to be dyed (a pack consists usually of not more than three dozen skins) is dealt with by two boys. They first lift the pile of goods over the top of the tray part by part as they are able, one boy taking hold of the hind shanks and the other boy taking hold of the fore shanks, and lower them carefully into the dye liquor, placing them at one end of the tray. The dyestuff that is judged enough to dye the pack has been previously dissolved, and about half of the solution together with a sufficiency of hot water to make a bath for the pack has been placed in the tray. The bath on beginning the work is usually at a temperature of about 55° C. (131° F.); the temperature, by the immersion of the cold skins, soon lowers down to about 45° C.

§228. At once on the goods being immersed in the dye-bath, the 'turning' of them is started. The two boys, one standing at each side of the tray, take hold of the top pair of skins of the pile, each boy taking hold of the pair by the hind shanks with one hand and with the other hand taking hold of the skins about half-way down the middle, near the centre of the belly (see the illustration), and they thus lift up the pair and then turn the pair over, so that the skin that was uppermost is now undermost, and place the pair at the further end of the tray. Treating the next pair of skins in like manner, and each succeeding pair, the whole pack of goods is rapidly transferred by the boys to the further end of the tray. This is their first 'turn,' and the pack then, with no delay, goes in the same way through a second turn. And so on until the goods are dyed to the required depth of shade, ten or twelve turns being usually necessary. A further portion of the dyestuff solution is added to the liquor during the turning. This method of turning is only to be recommended when a comparatively small pack of goods (say one dozen skins) is under treatment, owing to the danger of the bottom pair of skins becoming unevenly dyed if left for some little time without turning. When large packs are being dyed the method described below (§230) is usually followed.

§229. Another method of turning, as follows, which can be carried out with a shorter tray, is adopted by some dyers, and is convenient when small skins are being treated. The pair of skins at the bottom of the pack are pulled from underneath and transferred to the top. The operation is repeated with the pair of skins that is now at bottom. And so on, the procedure being persevered in until each pair of skins has been moved ten or twelve times from the bottom to the top of the pack. As each pair is pulled from the bottom of the pack, the pair is turned over before transference to the top. The method is only useful with small packs of goods.

§230. The more customary method of turning, when, as is usual, the pack of skins in work is too heavy to allow of the

drawing of the pair of skins from underneath varies the procedure described above, thus. The top pair of skins is lifted and turned over, and placed at the right hand end of the tray. The succeeding pair is then treated in the same manner, and so on until a quarter of the pack or thereabouts is at the right-hand end. The pack at the left hand being thus lightened, the pair of skins at the bottom of it can be pulled out, turned over, and placed on the right-hand pack, and so on with all the other pairs at the left-hand end. Similarly working with the now full pack at the right-hand end, it is transferred to the left-hand, and the working from end to end in this way is kept up until the operator judges that all the pairs of skins in the pack are in equal condition as regards their dyeing.

§231. The tray method has this great advantage when goods are being dyed to pattern—that they are under continual observation. But it has serious disadvantages. The keeping of the skins constantly in motion involves much labour. As the skins, each pair, are exposed to the air at each turn, the dye-bath, apart from some special means of keeping it hot, soon becomes cold, the dyeing being thus considerably slowed, especially towards the end of the process. The method, moreover, is not economical, the liquor after the dyeing of a pack of skins being in most cases very incompletely exhausted of its dye.

§232. Dye trays are sometimes made of sheet copper. Copper trays, however, are not to be recommended, especially when the 'acid' dyestuffs are to be employed. The addition of acid, that is necessary with these dyestuffs, is liable to dissolve any impurity in the copper, and this has a mischievous effect upon the goods under treatment, and dulls the shade of colour.

§233. THE TWO-TRAY METHOD.—When stock shades are to be dyed the two-tray method, a method often practised on the Continent, and now to be explained, may be employed with advantage. The method just described may be called the English method. The skins to be dyed in the two-tray method are first

divided into convenient packs, and paired flesh to flesh. Let us suppose that they divide conveniently into four packs. A strong solution of the dyestuff to be used is then prepared in the usual manner; in quantity the solution being from four to five times, in pints, the number of the packs of skins to be dyed. In the present instance there are four packs of skins to be dyed, and from 16 to 20 pints, say 19 pints, of the strong solution would be prepared.

§234. Now two trays are provided, much after the dimensions above given (§226), but not so deep. And three liquors are prepared, with hot water, each of sufficient quantity to take one of the packs of skins. One of the liquors contains one pint of the solution, another two pints, and the third contains one quarter of the remainder of the solution, 4 pints of it, that is. Let us term these liquors respectively, weak, medium, and strong. The weak liquor is now poured into one of the trays, and the medium liquor into the second, and a pack of skins is worked and 'turned' through the weak liquor. After being worked through the weak liquor, the pack is removed from it, and worked and 'turned' through the medium liquor. The working of the skins through the weak liquor having exhausted it of its dye, the liquor is thrown away. Into the emptied tray the strong liquor is now poured, and the working of the pack of skins through this strong liquor completes their dyeing.

§235. The weak liquor, exhausted of its dye, was thrown away, as just above stated. But by the passage of the skins through the medium liquor, much of the dye contained in the liquor has been taken up, and it has become the 'weak' liquor. In like manner the working of the pack through the strong liquor has lowered its dyeing value, and it has become the 'medium' liquor. Through these two liquors, weak and medium, the second pack of skins is worked. After the working, the weak liquor is thrown away, just as was the weak solution in the case of the first pack of goods, and into the emptied tray is poured a strong liquor, which has been prepared with, again, 4 pints of the reserve solu-

tion while the so far dyeing of the second pack was proceeding, and in this strong liquor the second pack has its final working.

§236. By this final working of the second pack of goods, its 'strong' liquor has become a 'medium' liquor, just as its 'medium' liquor has become a 'weak' liquor. The third pack of skins is now worked successively through these two liquors, the exhausted weak liquor is thrown away, and there is poured into the emptied tray a strong liquor, prepared again with 4 pints of the reserve dyestuff solution; the completion of the dyeing of the third pack taking place in this strong liquor.

§237. Four pints of the reserve solution remains. This makes a strong liquor for the fourth pack of goods, these being first worked through the two liquors left from the third pack, and the liquor that is exhausted by the working through it of the third pack, the 'weak' liquor of the third pack, that is, having been thrown away.

§238. The temperature of the several baths should be about from 45° to 50° C., and each pack should be worked in each bath for from five to ten minutes.

§239. It will be seen that in the procedure just described, each pack of skins goes through three separate baths, commencing with a weak bath when the skins are greedy for the dye, and finishing with a strong liquor, which may be much stronger than the bath used in the English tray method. This finishing liquor, strong and hot, produces a fulness and evenness of shade unobtainable by the English method. The method is, moreover, extremely economical in dyestuff, and it, as well, keeps the goods always under observation.

§240. It is handy to reckon the quantity of strong dyestuff solution to be prepared, by the number of the packs of skins to be dyed, and to reckon the quantity in pints. The number of packs above was four, and 19 pints of solution were prepared; that is to say, 4 pints of the solution for each strong liquor of each pack, and a margin of 3 pints over for the weak and medium

liquors of the first pack. If there were 6 packs of goods, then, still reckoning 4 pints for each strong liquor, there would be 3½ gallons, about, of solution to prepare. If 7 packs, then about 4 gallons and so on.

§241. When this method is employed, only single dyestuffs should, as far as possible, be resorted to. If mixed dyestuffs are used there is likely to be considerable variation in the colour of successively dyed packs of skins, as each dyestuff has its own distinctive character, its own individuality and way of 'taking to' leather, as it were; so that when one pack of skins has been dyed, the conditions for the dyeing of a second pack are no longer the same as they were for the dyeing of the first pack.

§242. Paddle Dyeing.—The paddle is an appliance constructed mainly of wood and consisting of an outside vessel, which holds the dye liquor, and a wheel furnished with blades or paddles. The wheel is mounted on the top of the outer vessel, in such position that, upon rotation, its blades dip below the surface of the dye liquor and set up a current in the liquor. (See Figs. 54, 57, 58, 59).

§243. There are three distinct forms of paddle on the market, respectively bad, indifferent, and good. The worst form is the box form, (Fig. 57), in which the paddle-wheel is fixed on the top of a rectangular wooden box. For the current set up in this form by the rotation of the paddle hardly reaches the bottom corners of the box; the liquor there remains practically stagnant. The consequence is that if a skin, as does happen, gets into a corner of the vessel, there it remains, with the result that, if not attended to, the dyeing of the skin is uneven. This attention means the stirring up with a wooden stick of the skins that get out of the current, means that is to say,

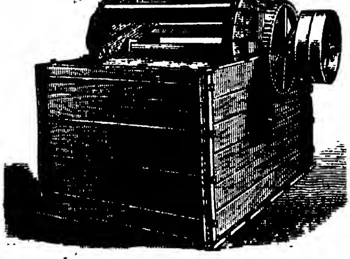


Fig. 57.

the constant watching of the paddle. The illustration is of a paddle which has a wheel and pinion to reduce speed. The addition, however, is not necessarily a part of a box paddle; it is only required when the main shafting runs very fast.

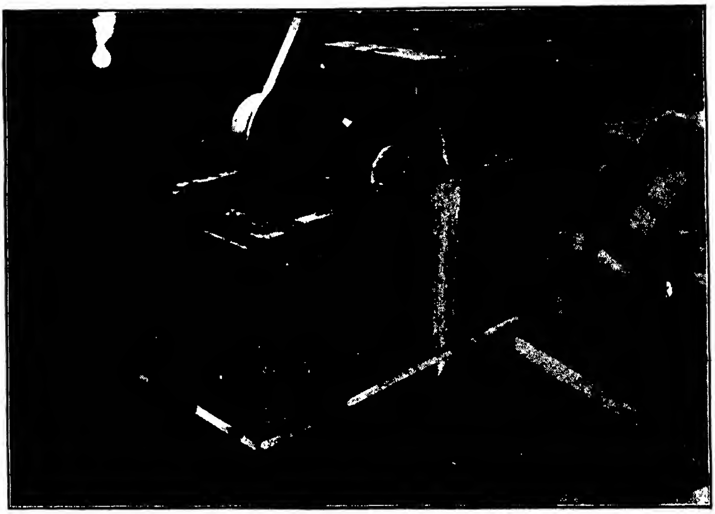


Fig. 58.

§244. The paddle method of dyeing is very commonly employed when skivers, basils, 'Persians,' &c., are under treatment, and the best mode of procedure with them, especially when a large pack is to be dyed, is to first place the goods in the paddle, this having already been filled with water at a temperature of about 52° C., so as to allow for the cooling down of the water to about from 45° to 50° C. by the entry of the cold skins, and to make the first addition of concentrated dye solution after the paddle has been set in motion. Further instalments of the solution are added at intervals as found necessary.

§245. The procedure just set forth is a better method than the common one of making the dye-bath first in the paddle, then

starting the paddle, and then adding the goods. Quite several minutes must elapse before the goods, all of them, especially if there are 12 dozen or more in the pack, can be got into the vessel, and the skins first entered have become dyed before there is a circulation in the liquor equally affecting them all, differences of colour in the pack when fully dyed thus coming about as well as unevenness of colour in individual skins; for it is obvious that the uniformity of diffusion of the dyestuff in the water is disturbed by every entry of fresh skins.

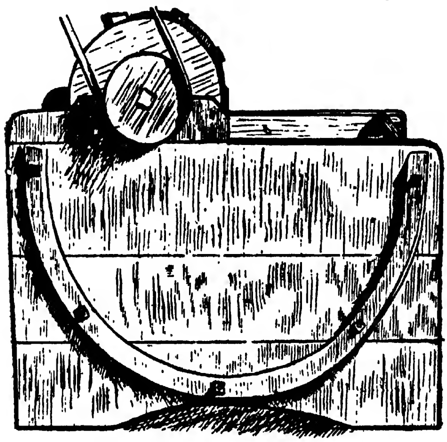


Fig. 59.

§246. There is represented in Fig. 60, as will be noticed, an arrangement which permits the addition of the concentrated dye-solution to the bath whilst the paddle is in motion, without much danger of staining the goods. The device consists of a box A with perforated bottom, fitted either at the back, or in front of the paddle. The advantage of this method is that the feeding-in of the concentrated dye-solution to the liquor is gradual, and the solution in its concentrated form does not come into contact with the skins. In the common method of pouring the dyestuff solution into the paddle at the top there is always a danger of staining one or two skins, and if the dyestuff is poured down a wooden spout placed at a corner of the paddle, then there is the liability of a skin being caught by the end of the spout and getting considerably stained.

§247. In a somewhat better form of paddle that is on the market, the wheel is mounted centrally on the top of a part-

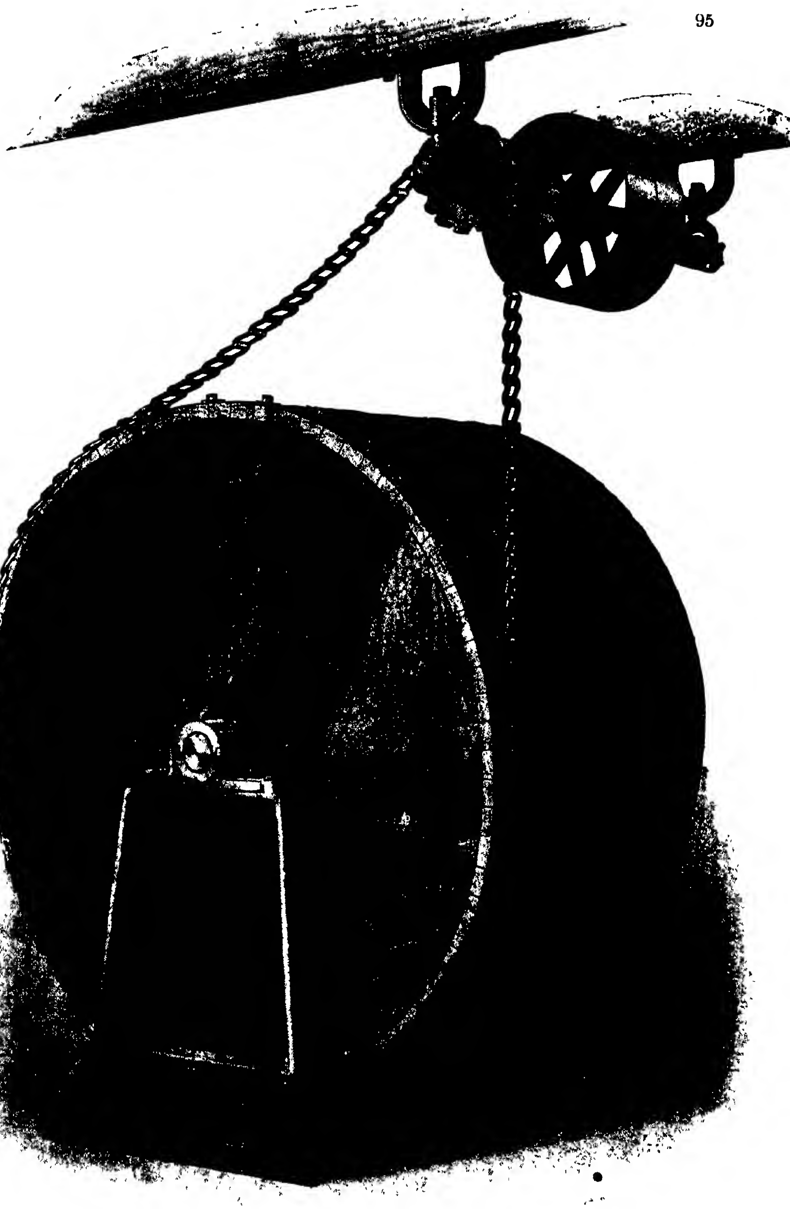


Fig. 59a.

cylinder vessel;—a somewhat better form, that is to say, than the Fig. 57 form. Illustration is unnecessary. The part-cylinder in this form of paddle, however, is but a small part, and the vessel is shallow. The form is faulty in that there is a liability of goods getting behind the wheel and remaining there, the current in the liquor being in great part always forward of the wheel, and not much movement of the liquor taking place behind it. This again is a form of paddle that calls for continual attention.

§248. A properly constructed paddle should need no such attention, there should be no waste labour in respect of it, the goods should swim round continuously in the current set up by the rotation of the wheel and want no watching. In the form of paddle shown by experience to be the best, the vessel to contain the dye-liquor is a semi-cylinder (Figs. 59 and 60), and the wheel is set back from the central line, as shown in the Figs, and dips well down into the liquor. A current (see Fig. 60) such as the arrows represent, is then set up, the blades of the wheel catch the skins as they pass, and the skins are thus helped in their movement round. The paddle may be made in the form of a rectangular box (Fig. 58), but if so made, the ends must slope inwards from the top as the Fig. shows, or the inner bottom corners must be filled in and well rounded off, the shape of the vessel being thus brought into line as it were with a semi-cylinder. In Figs. 57, 58, 60, of paddle, the front is to the left, in Fig. 59 it is to the right.

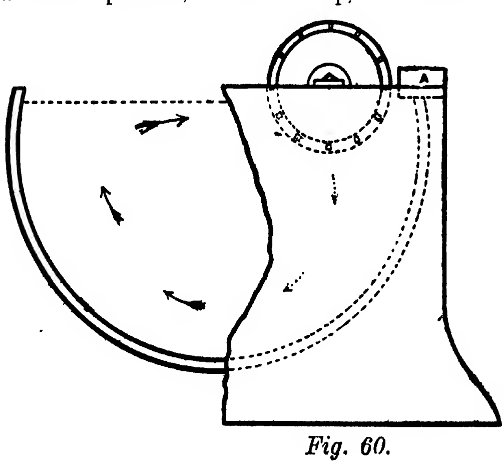


Fig. 60.

§249. The paddle liquor can be heated during a dyeing operation if desired, by a steam-pipe fitted under the paddle and opening into it under a false bottom.

§250. With a properly constructed paddle no labour is required to keep the goods in motion and the dyeing is more even than with the tray method. The method has disadvantages, however, as compared with either the tray method or the drum method, (presently to be described); what may possibly be regarded as the chief drawback of the method being that it is decidedly wasteful of dyestuff, using up more than does either the tray or the drum method. This is because of the large quantity of dye-solution required for the bath, and that the bath is never exhausted, for the reason that it must always be maintained at full strength. There is the further disadvantage that the flesh sides of the skins are dyed, which in certain classes of goods is not desired. And further, unless the paddle is furnished with the steam-pipe just referred to, the bath quickly cools down, the liquor being in continuous motion and exposed to the air. If the paddle is not fitted with a steam-pipe, there should be a cover hood to it. The paddle method of dyeing has the advantage that the skins can be examined during the dyeing without stopping the paddle. A point to be mentioned is, that in the case of heavy skins, such as calf, the paddle method of dyeing raises the grain of the goods to a very appreciable extent.

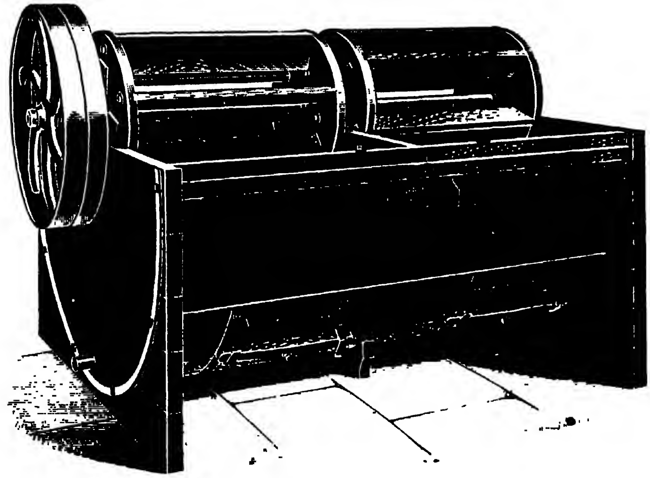


Fig. 61.

§251. A 'twin' paddle is shown in Fig. 61. In this form there are two independent liquors in the one paddle.

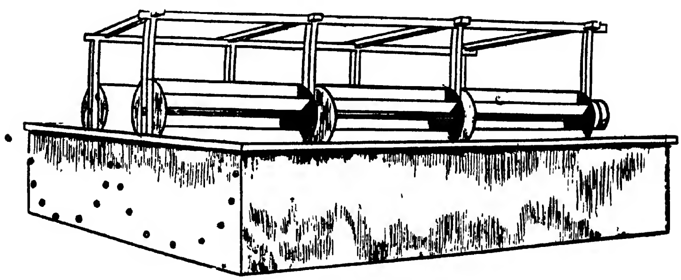


Fig. 62.

§252. A 'battery' of paddles is represented in Fig. 62. The number of paddles of the battery is here six, but it may consist of any convenient number of single paddles. The arrangement has but one drive.

Drum Dyeing.

§253. A 'drum' is a box or case, generally of wood and mounted on an axle, the whole construction running in bearings fixed on rigid standards. The drum is of suitable dimensions to hold the skins that are to be dyed at one working, together with the water and dye solution necessary for the goods. The shapes of drums are various. In this country they are commonly in the actual form of that musical (or unmusical) instrument, the Bass drum, that is to say, they are cylindrical with flat ends. The body of the cylinder is built up of staves like a cask, and the axle goes through the centre of the ends or 'heads' of the drum. On the Continent, square or polygonal shapes seem to be preferred. Inside the drum, across it, at regular distances apart and attached to the staves, are rows of pegs, or narrow shelves. Goods are entered and removed by a close-fitting door. The axle is, or should be, hollow.

§254. What takes place in dyeing by the drum is the same for all shapes of it. The goods, by the rotation of the drum are alternately immersed in and taken out of the dye solution. The utility of a hollow axle is manifest. If there is no such axle, the

goods must of necessity be treated, from the very beginning of the dyeing, with the concentrated solution of the whole of the dyestuff. When, however, the axle is hollow, the drumming of the goods can be commenced in water only, and the dyestuff added gradually through the hollow axle. Much greater evenness of colour is thus obtained, the goods being worked in a weak solution when greedy to absorb the dye, and the solution being strengthened as the absorption becomes slower. As the drum rotates the rising shelves or pegs lift the skins out of the solution and carry the skins with them. The rotation continuing, the skins fall back into the solution from the shelves or pegs as these rise higher and higher, and this alternate dipping and lifting of the skins goes on so long as the rotation of the drum is kept up. It is preferable to fit the drum with shelves rather than pegs, the former being less liable to hold on to the goods in such way as to damage them.

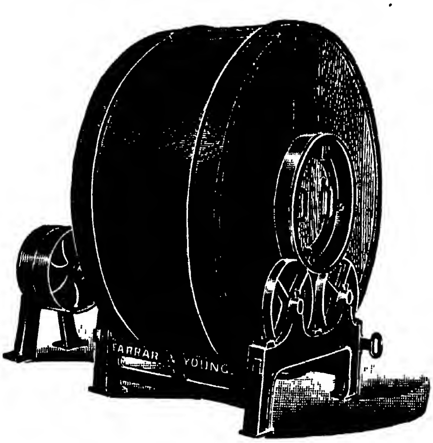


Fig. 63.

§255. In choosing a drum for dyeing, an essential consideration is the position of the door. In the round or short cylinder form of drum, (Fig. 64), the door is usually in a head of the drum and near the periphery, or else it is in the staved body of the drum, (Figs. 59a and 70), Fig. 64 has both doors. Neither of these positions is suitable, and especially are the positions objectionable when the drum does not possess a hollow axle. With the door of a drum in a head of it and near to its edge, the packing of the goods in the drum is inconvenient, particularly so if the skins are to be placed on the shelves, for the workman must then, to his waist, get inside the drum. The loading of a

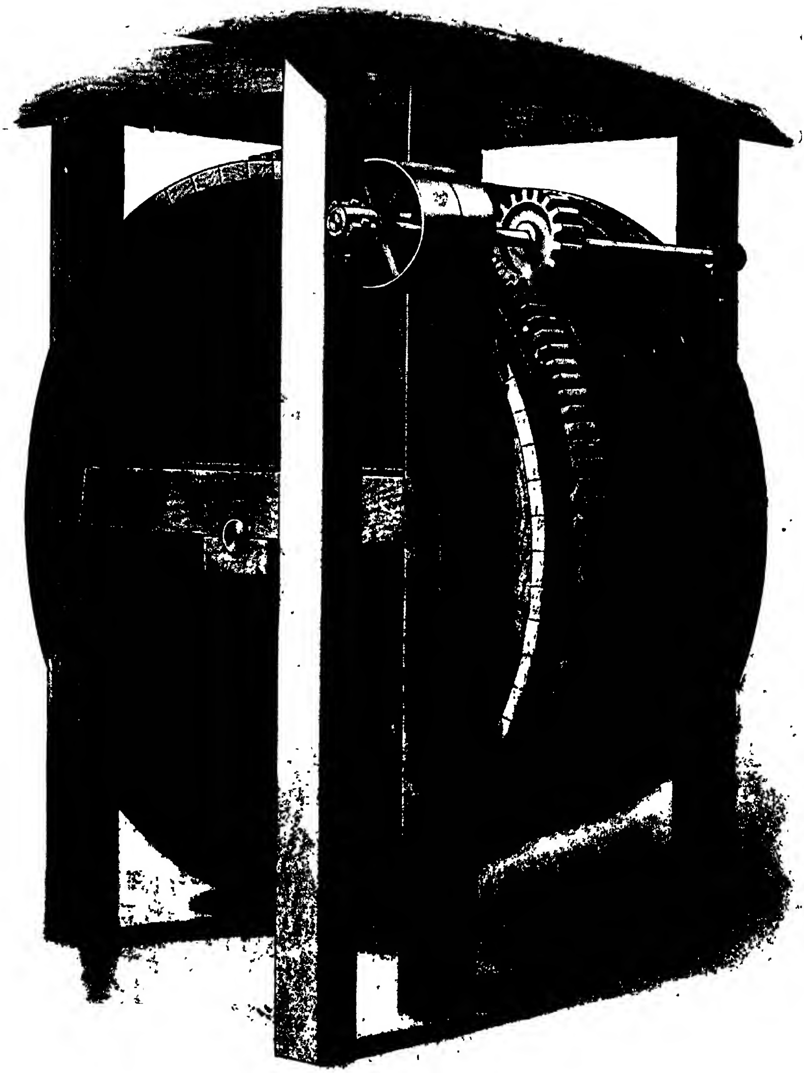


Fig. 64.

drum of this description takes considerable time when large lots of skins are being dealt with, and the workman is in danger the whole of the time, for the drums drive by power, and should the machinery happen to start, the workman would be jammed between the drum and the rigid framework of it. Of the two positions mentioned for the door, the better is that where the door is in the staved body of the drum (see each of the Figs.), though the position is by no means faultless, for there is still risk to the workman who is loading. And it is, besides, a very difficult matter to avoid leakage from a door so placed, a leakage that goes on all the time the drum is rotating. To obviate leakage one manufacturer makes the door partly of metal, and furnishes it with a metal frame, into which frame the door fits watertight. But metal doors are cumbersome, and their weight affects the balance of the drum, and further, it requires a very strong man to lift such a door and place it in its seat.

§256. The best place for a door is the centre of a head of the drum, when it is unimportant if the fitting is not perfectly watertight, for very little leakage will take place even if the drum is rotated without the door. A form of drum with central opening for door is shown in Fig. 63. Such form, moreover, makes it possible to have a large door, so that the drum can be loaded quickly and with very little risk to the workman. Further, the door should be so light that one man can easily remove and replace it whilst the drum is in motion. With such a door access to the skins for their examination is possible as the dyeing progresses, and the advantage possessed by the tray and paddle methods of dyeing, of easy inspection of goods during the dyeing processes is thereby secured. Description of two such doors presently follows, but a few words as to the drum itself are first necessary.

§257. The opening into the drum is surrounded by a large iron double-flanged ring, and the frame-work of the drum on that side of it is fitted with two free-running friction-wheels, on which, by means of the ring, the drum on that side rests, the rims of the wheels fitting easily between the flanges of the ring. The

drive of the drum is from the other side of it, there being a pinion on the shaft of the driving pulleys, which gears with a large wheel fixed concentrically with the drum, and there also being on that side a short axle at the drum centre. When the drum is in motion, it rolls on the friction wheels on the one side and the axle turns in a fixed bearing on the other.

§258. Figs. 70 and 72 are of drums with their doors in the stave bodies of the drums, just as were Figs. 59a and 64. In the latter Fig. the framing is of wood, in Figs. 59a, 70, and 72 the frames are of iron. The axle in Fig. 59a has roller bearings. Both Fig. 70 and Fig. 72 show the drive just referred to, of pinion on driving shaft gearing into a wheel fixed to the drum. An entirely different form of drive, a rim-gear drive, is shown in Fig. 64. Here a pinion on the driving shaft gears into a wheel which is built up of segments fixed on the rim of the drum, and bolted to the staves of it. Another form of drive is illustrated in Fig. 59a. On the driving shaft, which is overhead, a sprocket wheel is fitted, and this gears into a chain, which in turn gears with studs fixed to the drum-staves near the drum edge. The drives shown in Figs. 70 and 72, either of them, are convenient ones for a drum with central opening for door, such as Fig. 63 shows, and as we are now treating of, in the further head of the drum. And the chain drive is specially suitable when a drum is to be placed in some out of the way corner and space is limited.

§259. The drum door now to be described, (Ley's drum door), had its origin in a suggestion made by the writer as to the need for such a door, and a description of it as first laid out appeared in the writer's pamphlet, "*Drum Leather Dyeing.*"* The door, as originally made, was of wood mostly, upwards of 2ft. in diameter, and weighed somewhat over 18lbs. The illustration, Fig, 65, represents it.

*Journal Society of Dyers and Colourists, Dec., 1902.

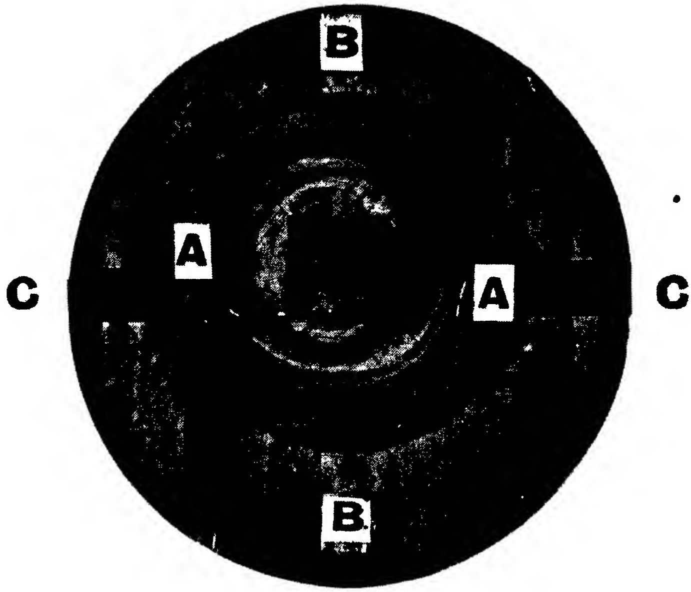


Fig. 65.

§260. The door is in two parts, B and A, which have a certain amount of circular play one upon the other. A central bolt, as axis, is common to both parts. The part B, the outer side of which is shown, seats on to the drum, and has a central projecting portion on its under side which fits the drum opening. C, C, are spring bolts fixed on the outer side of B. Attached to the A part of the door is a handwheel, seen in the illustration, which can be grasped with both hands. Fixed to the periphery of A are two cams, projecting downwards. On each of the spring bolts a pin is fixed, and when the various pieces are in their normal positions each of the pins is just inside a cam. The ends of the bolts C project beyond the edge of B, and are sloped like the spring bolt of an ordinary door-lock. Around the opening into the drum a flanged ring is fixed.

§261. The manipulation of the door is as follows:—Taking the handwheel in both hands (see Fig. 66), the operator snaps the door into its seat. The sloping ends of the bolts, impinging upon the

flange of the ring, yield, and then recover themselves on the under side of the flange, (just as the spring bolt of a door lock impinges upon the box-staple in the closing of the door, yields, and then recovers itself inside the staple). The door is now fixed, and revolves with the drum in the direction say of the hands of a clock. When the operator wishes to remove the door he again grasps the handwheel with both hands, thus stopping the motion of the A part of the door. As the B part however continues to revolve, the pins on the spring bolts, which, being fixed to B, are moving with it, slide along the inside edges of the cams, which are stationary, and so draw back the bolts. (They are drawn back in the Fig.) Directly these are drawn back the door is loose in the operator's hands, and he can remove it. If he does not immediately remove the door, but continues to hold it, it simply remains motionless, whilst the rotation of the drum goes on. There is nothing whatever to catch his hands or in any way do him injury. If he lets go the handwheel, the door falls. Having removed the door, the operator, by means of the handwheel, turns the A part of the door upon the B part in the direction of the hands of a clock, so that the bolts are no longer held back by the cams, but recover themselves, and the door is again ready to be snapped into its place.

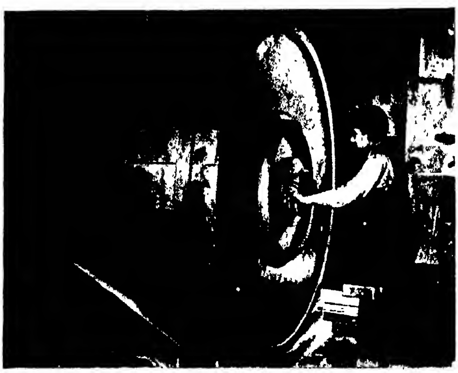


Fig. 66.

§262. Another central drum door, (Fig. 63) also removable and replaceable without stopping the drum, has been placed upon the market by Messrs. Farrar and Young. The door is light, and made either of wood bound with metal, or entirely of aluminium, and it holds to the drum by four metal buttons, and is furnished with two light handles by which to remove it from the drum or replace it.

§263. The hollow axle that drums should have (§254) becomes, on the door side of the drum, in the case of drums with door in the centre of one of the circular heads, the flanged ring that surrounds the opening, and the feeding of liquor or dyestuff into such drums is by means of a pipe through the centre of the door, the drum and door both rotating round the stationary pipe.

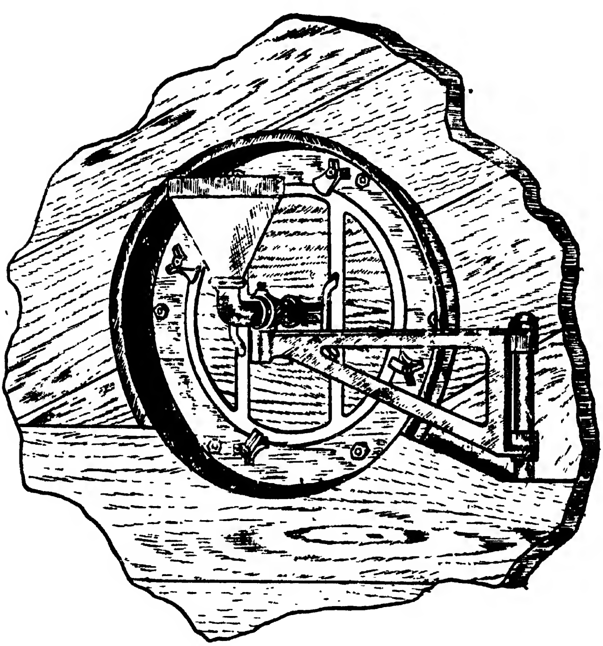


Fig. 67.

§264. Fig. 67 shows a feeding arrangement with a central door such as last described. The feeding funnel and the pipe through the centre of the door are there seen. The funnel and pipe can be swung away from the door when access to the drum is necessary, by means of the bracket which hinges on the upright pin fixed to the drum framing just in front of the drum. The door, as stated, can be made to come away along with the funnel and pipe, or it may be independent of these.

§265. The feeding into a drum is usually done through the hollow axle (§254), by means of a pipe which is connected with a wooden box placed in a convenient position outside the drum, from which box the dye solution or other liquor flows into the drum by gravity. The feeding of a drum with central door has been above, (§264), illustrated.

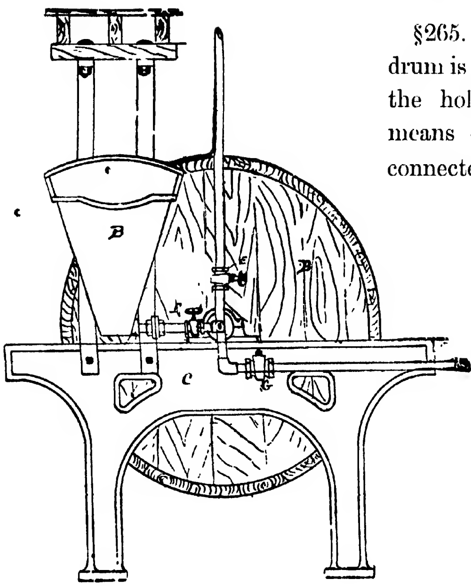


Fig. 68.

§266. The Fig. 68 illustrates a convenient arrangement for feeding through the hollow axle of the drum. This consists of an ordinary box or 'hopper' B, and two pipes E and G, fitted with cut-off taps; one of these pipes, say E, is connected with either hot water or steam supply, and the other pipe G with cold water. The drum can then be filled through the axle with the necessary amount of water at the required temperature, and the dissolved dyestuff afterwards added as required.

§267. A method of feeding a drum otherwise than by box or funnel is shown in Fig. 69. An ingenious contrivance is here represented that has been thoroughly tested in the author's dye-house and found most useful. The dye solution or other liquor is here forced by pressure into the drum in the form of a very fine spray. First the solution or liquor is pumped by hand into the cylinder at the left of the Fig., until an attached gauge registers a pressure of 45 lbs. to the square inch. The cylinder is then connected up to the drum by means of flexible

tubing, and the contents of the cylinder is sprayed into the drum as this revolves. The spraying ensures an even distribution of the dye solution in the drum, and as the spraying is under complete control by the tap seen in the Fig., the solution may be added in as small a quantity at a time as may be desired.

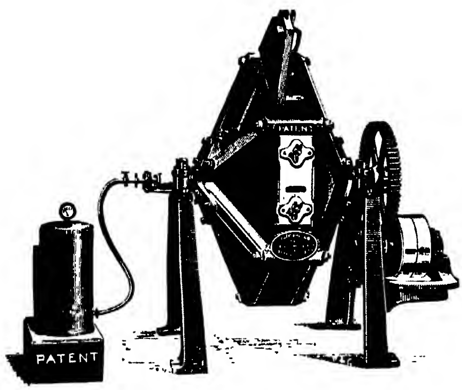


Fig. 69.

§268. This adding solution by spray has been found particularly useful by the author when fat-liquoring, (Chapter XII.); the fat-liquor being as it were re-emulsified by its passage through the fine spraying-nozzle. Even a badly emulsified fat-liquor is distributed throughout the goods with perfect evenness by this spraying method of fat-liquoring.

§269. Necessarily, drums with the door in the centre of one of the heads do not allow of so large a number of skins being treated at one time as drums that have the door in the staves. Drums with central doors are of special value when dyeing to pattern. A drum which has its door in the staves can be loaded from the floor above, through a trap door in the floor. When large numbers of skins are being treated, it is very economical in labour to have the shaving machines on the first floor of the factory, and the drums on the ground floor, and to load each drum with the shaved skins direct, through the trap door over it, the drum being stopped with its door exactly under the trap door opening.

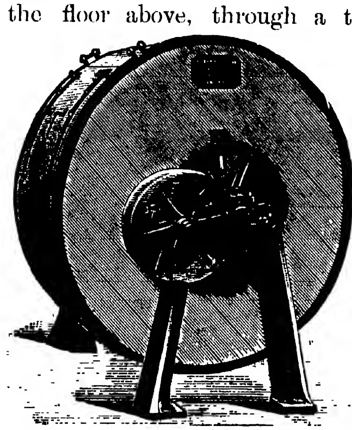


Fig. 70.

§270. OTHER TYPES OF DRUM.—Figs. 69 and 71 show a drum particularly adapted for goods which need a rather more violent treatment than is obtainable with the cylindrical drum, as, for example, when hard leathers have to be treated, or skins like glove or calf kid, which require a vigorous drumming and squeezing action. The wedge-shape sides hold and squeeze the goods during the greater part of each revolution, and the skins become loose enough to drop only as they are reaching their highest position. The uppermost layer of goods is continually sliding off during the motion of the drum, and therefore goods are being continually opened out and 'balling up' becomes impossible.

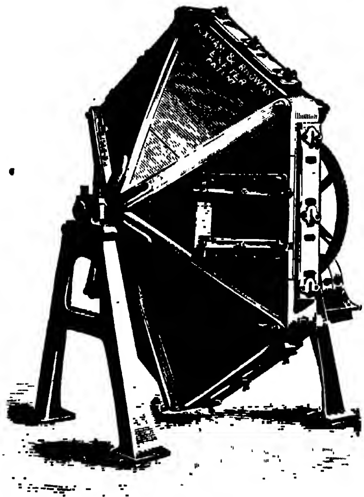


Fig. 71.

§271. The form of drum called the 'Drunken Drum,' is not so well known as other forms. This drum has an eccentric attachment to both axles that causes the drum during rotation to sway from side to side. The advantage of this drum is that the goods have a crossways movement as well as that arising out of the rotation of the drum; a distinct advantage when the drum is exceptionally wide and the liquor can be fed into the vessel from one end only. The crossways movement ensures against the danger of the goods nearest the feed getting more than their share of the liquor with which the goods are being treated; a very real danger in the case of exceptionally large drums. The like movement can be given to the goods by having the shelves inside arranged alternately at different angles to the ends.

§272. Drums are sometimes fitted with reversing gear which allows of a drum rotating so many times, (usually six), in one direction, when the direction automatically changes and the

drum revolves six times in the reverse direction. Fig. 72 represents a drum thus fitted. The continual change of the direction of the drumming prevents the goods becoming tied up in knots, as for instance, hide bellies might be. This type of drum requires

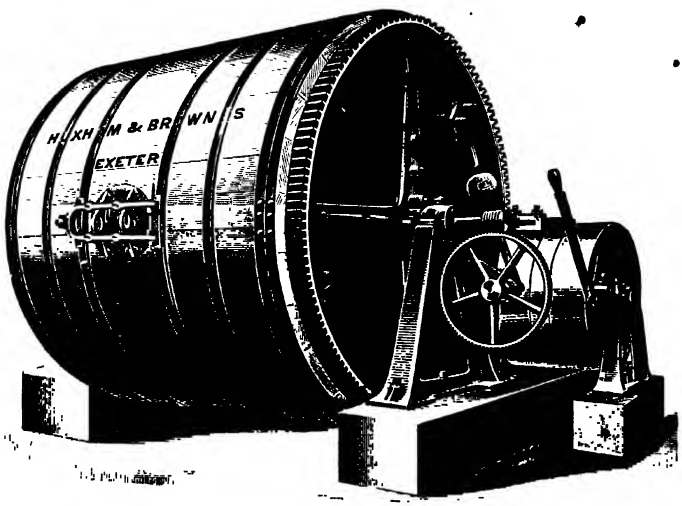


Fig. 72.

considerable power to drive, for at every change in the direction of rotation, the momentum acquired by the heavy drum up to the moment of change has to be overcome, and the drum has then after that to be started from the position of rest.

§273. Drums should be built of well-seasoned timber. Very suitable woods for them are either red deal or pitch pine. The latter wood is particularly suitable because of its property of quickly swelling on becoming wet, and its having no tendency to rot when kept continuously wet. The planks should be fixed to one another with mahogany or teak dowels.

§274. Complaint is sometimes made in respect of drum leather dyeing, that two packs of skins may be taken which are of the same tannage and have gone through the same preparatory treatment, and that these packs may be dyed one after the other

in the same dye solution and each pack for the same length of time, but that still the packs do not come out the same shade of colour. When this occurs the cause may be sought for either in that the same quantity of water was not used in each case so that the strength of the dye solution was not the same for the two packs, or that the packs were not each worked at the same temperature.

§275. Quite commonly, for want of the requisite conveniences the quantity of water used is not measured; measured, however, it ought to be. A convenient method of measurement is to have a tank fitted above the drum of such size as to exactly contain the quantity of water needed for a pack of goods; and the supply pipe to the tank to be fitted with a ball-valve which cuts off the water supply when the tank is full, the lever of the ball carrying a click which engages with a detent so that the ball remains suspended. Besides the water supply-pipe a steam pipe is run into the tank, and steam is blown into the tank when full of cold water until the water is of the required temperature. Now the cock is opened of the pipe which connects tank and drum and the tank empties into the drum. To re-fill the tank, a pull upon a small chain connected with the back of the click releases this from its engagement with the detent, the ball falls and opens the valve, and the tank fills again ready for the next pack of goods.

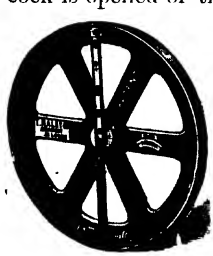


Fig. 73.

§276. The temperature of the liquor for a pack of goods must be regulated by a thermometer.

§277. Thermometers of various forms (Figs. 73 and 74) are made for drums and they are variously fixed. The head of a drum is the proper place for its thermometer.

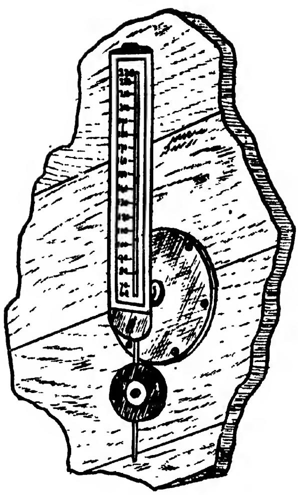


Fig. 74.

§278. If the door of the drum is near the staves, the thermometer may be fitted toward the opposite edge, and so fitted that when the drum is stationary in position for loading, the thermometer bulb is below the liquor level.

§279. Some of the thermometers made for drums are weighted at their lower ends, and so constructed and fitted to the drum that they retain their upright position during the rotation of the drum. Fig. 74 is an example of this type.

§280. If the drum door is central the best course to adopt is to have several thermometers, say three, fixed to the drum in such positions that one of them is always below the liquor level. The annexed illustration, (Fig. 75), makes the arrangement clear; it is besides not expensive. With this arrangement the thermometers need not be weighted to retain the upright position. No matter what may be the position in which the drum comes to rest, the thermometer that is below the liquor level is never so far out of upright but that it can be easily read off. The bulbs of thermometers, protected by wire cages, are inside the drum.

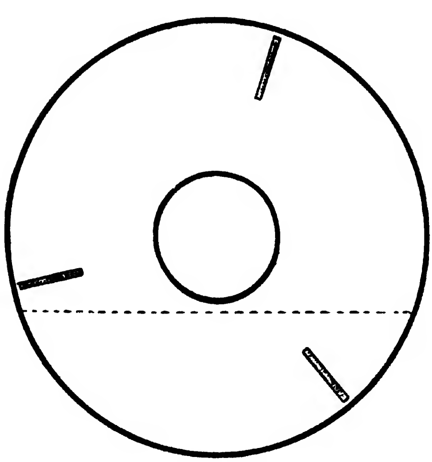


Fig. 75.

§281. The want having been felt amongst leather dyers of a drum from which the liquor can be run off without its being stopped or having its door removed, drums have been made pierced with holes around them into which pegs are fitted, which can be pulled out while the drum is being rotated.

§282. Where the peg system is adopted, a convenient form of peg to use is shown in Fig. 76. This peg has a boss head inside the drum, and cannot be entirely withdrawn from its hole. It is also bored centrally, in the direction of its length at the head end, the bore extending about half way down the peg; and a hole bored through the side meets the central boring. With the peg in position, as shown in Fig. 77, there is no passage from the drum by which the liquor can run out. With the peg loosened as shown in Fig. 76, the liquor can escape freely. The boss head of the peg is attached to the body of the peg by brass screws.

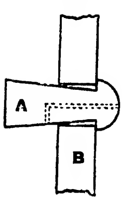


Fig. 76.

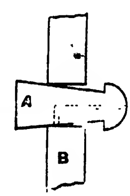


Fig. 77.

§283. Another method of emptying the drum is shown in Figs. 78 and 79. Fig. 78 shows a plug or stopper, of any practicable large size, and having a prolonged end *a*. The plug fits into a hole made in the drum. Further, rigid with the drum, is a circular collar CC, which gives bearing to a helix spring, represented by the thick black line B, which spring holds the plug A firmly in its seat. D is a lever pivoted in an upright piece E, also a fixture to the drum. The lever D has a fork at one end (shown in the Fig.), which engages with a pin projecting from the A_1 end of the plug. The other end of D is furnished with a roller F. Fig. 79 (on a smaller scale than Fig. 78), shows by its line GG, part of the circle of the drum. H is a segment piece, pivoted at H_1, in the drum framing.

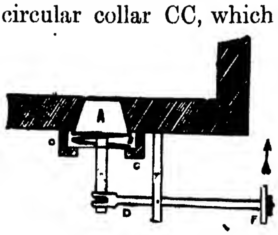


Fig. 78.

§284. The contrivance acts in this manner:—When the drum, moving in a direction contrary to the hands of a clock, is at work, there is nothing whatever to interfere with the plug or its attachments. When it is desired to empty the drum of its liquor, the segment piece H is raised, by lever or other convenient arrangement, to the position shown by the dotted lines. The roller F, as it now comes round to the segment piece, impinges on it, the roller end of the lever D being thereby moved in the direction of the arrow (Fig. 78). The spring B is thus compressed, and the plug A lifted from its seat. A detent, fixed in any convenient position, holds the lever D and prevents its resuming its normal position. The segment piece H is so placed that the lifting of the plug from its seat is effected when the plug part of the drum is at its lowest. When liquor has again to be put in the drum, the lever D is released from the detent that holds it, the plug springs back to its seat, and the valve is closed.

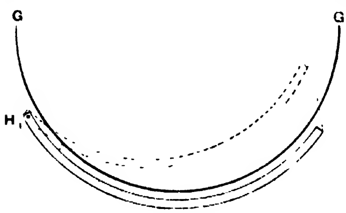


Fig. 79.

§285. It will be profitable to now take a pack of skins through the operation of dyeing, in a drum which is in continuous motion and from which the door can be removed and the liquor run off without any stoppage of the rotation.

§286. The goods, first thoroughly prepared, and in suitable condition to receive the dye, are well struck out and laid across a hurdle or stand handy to the drum. From this they are transferred to the shelves of the drum, which in the meantime has been filled with a suitable quantity of water at proper temperature. The door of the drum is now closed, the drum is set in motion, and one-third of the requisite amount of dyestuff, which has been previously dissolved, is run into the drum through the hollow axle.

§287. For the dissolving of the dye a steam jacketed pan, connected to the hollow axle of the drum by a removable pipe, is a great advantage, the weighed amount of dye-

stuff being placed in the pan, hot water added, and the mixture stirred until the dye is dissolved, the heat being kept up after solution of the dyestuff so that it may remain in solution. The 'drumming' is continued for ten minutes, when another one-third of the dyestuff solution, prepared as explained, is run into the drum. After now another ten minutes drumming, (see §286), the last one-third of the dyestuff solution is added, and the drumming goes on until the goods are dyed the desired shade, examination of the goods being made from time to time by removal of the door of the drum without stopping the rotation, to ascertain the progress of the dyeing, the depth of colour attained, and the evenness of the colour.

§288. If the acid colours have been employed, it is advisable, after the bath has received two-thirds of the dissolved dyestuff and the drumming has gone on twenty minutes, that it should be continued for a further ten minutes, the requisite amount of diluted acid being added in the meanwhile. This mode of procedure is infinitely preferable to the ordinary method of adding dyestuff and acid together to the bath, especially when the acid used is sulphuric acid; as the deteriorating effect of this acid upon the leather fibre is minimised, a very important consideration as already explained, (§§122, 156). At the end of the latter ten minutes drumming the final one-third of the dyestuff is added, and the goods are then drummed for from fifteen to twenty minutes longer.

§289. After the dyeing of the goods, the liquor should be run off (see §§281, 283), and the pegs (Fig. 77) should be pushed back, (or the large valve, Fig. 78, released, as may be), sufficient cold water run into the drum for the washing of the goods, and the goods should be washed for a few minutes; or longer if acid has been employed, in order to remove as completely as possible all trace of the acid.

§290. For the whole of the above procedure, there is no removal of the goods from the drum, and no stopping of its rotation. The drum is now once again emptied of its liquor, but rotation is still kept up, and the drumming continued for from

five to ten minutes with the pegs out (or valve open), so as to throw off from the goods as much moisture as possible. They may now be taken from the drum and struck out; this done they are ready for drying and finishing.

§291. From the description just given it will be recognised that the sphere of utility of a drum, the goods in which can be from time to time examined, and the liquor from which can be run off without any stoppage of its rotation, is by no means confined to dyeing, washing, and part drying of skins, but that it is possible to take a pack from the very crust, and to strip and wash the pack, sour and wash it, and sumach and wash it, as well as dye and wash, and part dry the goods in one continuous operation, a great saving in time and labour being thus effected.

§292. The Fig. 80 illustrates a very useful little contrivance for use in conjunction with machinery that it is desired to run for any *definite* period of time, and which, though originally intended for use in connection with washing, starching, and Laundry machinery generally, the author has found to be a most useful addition to drums, paddles and other machinery used in Leather Dressing. This small machine is so constructed as to be easily set to indicate time, and give an alarm at the end of any required period. In drum dyeing when it may be required to drum goods say for half-an-hour, the alarm is set to go off at the end of this time, when the alarm will continue to ring for some considerable time or until turned off. The alarm may be run direct from the shafting driving the machinery or from the machine itself. The author has found it a great convenience to be able to leave goods drumming for the required length of time, feeling sure that he could proceed safely with other work, and receive warning when the drum should be stopped.

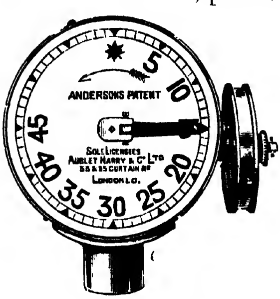


Fig. 80.

§293. For perfection of working with a drum it should have its own motor, so that it can be run quite independently of any other machinery.

DYEING MACHINE.

§294. Figs. 82 and 83 are diagram illustrations of a method, which is patented, of alternately dipping and withdrawing skins from the dyebath, with the view of avoiding irregularity of colour as between skin and skin, or unevenness of shade or clouded dyeing in any one the same skin from unequal immersion of its several portions. The skins are hung from frames or carriers which are attached to a rod having vertical motion in fixed

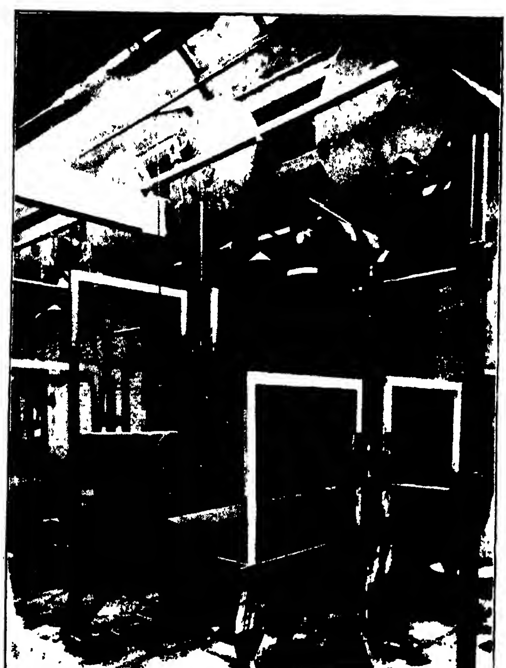


Fig. 81.—Rutteneau's Dyeing Machine.

guides. A is the driving shaft of the machine. To it is fixed a disc-crank, B, of which C is the crank pin. The connecting rod, D, is coupled to the crank pin at C and its opposite end is jointed

at G to a rod, E, which works vertically in the fixed guides, F, F. The skins in pairs flesh to flesh are hung over the carrier HH. By the down and up motion of the carrier the skins upon it are simultaneously immersed or withdrawn from the dye trays which are suitably placed on the ground for such immersion and withdrawal. The disc is balanced on the side furthest from C against the weight of D and E. The illustration, Fig. 81, shows four of these machines together in the one shop or shed. The carriers there are frame carriers. The machine has been found of greatest utility in the dyeing of skivers for hat leathers when the skins are required to have a clean undyed flesh side.

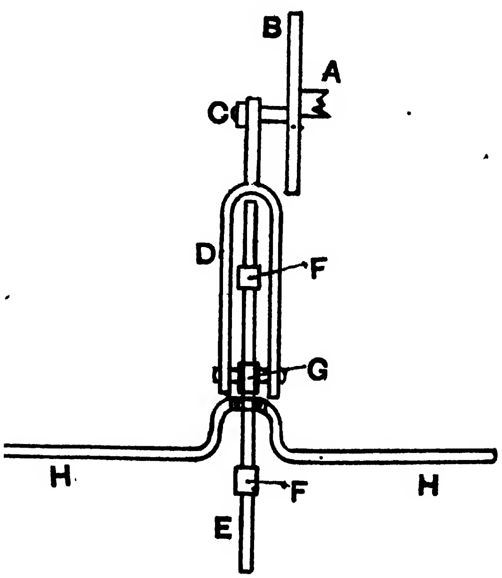


Fig. 82.

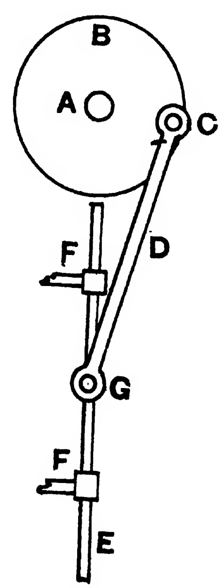


Fig. 83.

CHAPTER V.

ARTIFICIAL ORGANIC DYESTUFFS.

§295. COAL TAR DYESTUFFS.—Since the introduction of the first Coal-Tar colour, Mauve, by the late Sir W. H. Perkin, in 1856, the number of colouring matters, all of them derivatives of coal-tar, which have been placed upon the market almost defies enumeration. About 2,000 distinct such colours are known to commerce at the present time, and some of these, but comparatively few, are applicable to leather.

§296. Coal-tar dyes are often erroneously spoken of as 'Aniline' dyes. This has come about from the fact that aniline was the source of the earlier coal-tar colours of commerce. Many dyestuffs however are now prepared from other derivatives of coal-tar; for example, from napthalene and anthracene, and it is consequently more correct to speak of the whole of the dyes that are obtained from coal-tar, whether directly or indirectly, as coal-tar colours.

§297. When coal is distilled, the products of the distillation are four; (1) coal gas, (2) ammoniacal liquor, (3) coal-tar, (4) coke. By distillation of the coal-tar and further chemical treatment of it, various other products are obtained, of which the three following are the most important to the coal-tar colour manufacturer; (1) benzene, (2) napthalene, (3) anthracene, each of these products being the base of manufacture for a large number of dyes.

§298. As the present work is for practical men and not for the scientific student, the chemistry connected with the manufacture of coal-tar colours is in no way touched upon. It is the application of the colours and the different methods required for their different classes that this Chapter deals with. For the chemistry of the coal-tar dyes, the following English standard works on the

subject may be consulted:—Cain & Thorpe, *The Synthetic Dyestuffs*, (Griffin & Co.); Knecht, Rawson, & Lowenthal, *A Manual of Dyeing*, (Griffin & Co.); Benedikt & Knecht, *The Chemistry of the Coal-Tar Colours*, (Bell & Sons).

§299. Classification of Artificial Dyestuffs.—The dyestuffs may be classified,—(*a*) according to the bases from which they are derived, (*b*) according to their chemical constitution, (*c*) according to the methods in which they are applied. From the scientific standpoint the second classification is the best; for the needs of this work however the last is that which is required, and which alone needs to be discussed.

§300. Considered from the point of view of method of application to practical leather dyeing, the dyestuffs may be divided into:—

(1) Basic (or Tannin) Dyes.

(2) Acid Dyes.

(3) Direct (Cotton) Dyes.

(4) Mordant Dyes.

Of these four groups, the Basic-Dyestuffs, and the Acid-Dyestuffs groups are the most important.

§301. Basic Dyestuffs.—The basic dyestuffs are generally salts, compounded of organic colour bases, and hydrochloric acid; in some cases acetic, oxalic, sulphuric, or nitric acid is the acid constituent; or the dyestuff is a double salt, as of hydrochloric acid and zinc chloride.

§302. Basic colours are distinguishable from those of the acid group of colouring matters by the property they possess of being precipitated by tannins. The colour base combines with the tannic acid and produces an insoluble or sparingly soluble coloured salt or lake, and the acid constituent of the dye remains in solution. The base having this affinity for tannic acid, the basic dyestuffs should have an affinity for vegetable-tanned leathers, and this is so in practice.

§303. The basic dyes are distinguished by an intensity of colour much greater than that of the acid dyes, (§330). The basic dyestuffs dye vegetable-tanned leather very quickly, but have this great disadvantage, that, with one or two exceptions, they accentuate weak or defective grain; and unless great care has been taken in the preparation of the leather before dyeing so that the excess of tannic acid in the leather is distributed evenly, uneven shades of colour are likely to be the result, the dye 'working on' too rapidly where the tannic acid is in excess. The defect can be obviated somewhat by the addition of a small quantity of an acid, or of an acid salt such as potassium or sodium bisulphate, or of a neutral salt, such as sodium sulphate, (Glauber's salt).

§304. Acetic acid is one of the best additions to make to the dye-bath when employing basic colours. The effect of this addition is, as above stated, (§303), to lessen the rapidity of the dyeing. Too much acid however must not be added, or the colour may be prevented from 'working on' the fibre at all, and the dye-bath is not exhausted as it should be. In dyeing with basic colours, sodium bisulphate is a useful addition to the dye-bath, the resulting shades being clear and comparatively free from 'bronzing,' which is a characteristic feature of leather as ordinarily dyed with basic colours.

§305. When basic colours are dissolved in water which contains calcium or magnesium bicarbonates, (that is to say, if the water used possesses much temporary hardness), these salts act on the dyestuff, and a curdy, sticky precipitate is formed, the colour base being thrown out of solution, and a large proportion of the dyestuff thus rendered quite useless. The sticky precipitate moreover is liable to injure the goods under treatment, being deposited upon the skins, and causing streaks and spots. This is quite a common cause of defective 'Staining' (see Chapter X), when the precipitate is actually brushed on to the leather.

§306. The temporary hardness of the water to be used for dissolving the dyestuff, and in making up the dye-bath, should be first neutralised by the addition of acetic acid (Chapter IX); this prevents the precipitation.

§307. The attached patterns show most conclusively the loss of colour which takes place when the ordinary London water, with its hardness not neutralised, is used in the dyeing with basic colours.

Dyed with
Bismark Brown,
using London water.

Dyed with
Bismark Brown,
using London water
neutralised with acetic acid.

§308. Fixing Before Dyeing.—As the basic dyestuffs are precipitated by tannic acid, there is great loss of dyestuff when the leather contains an excess of tannic acid, arising from the bleeding out of the tannic acid into the dye-bath. The loss is serious, for, in fact, fully half the dyestuff may be thus wasted. It is therefore advisable, when using the basic dyestuffs, to fix the tannic acid in an insoluble form on the fibre of the leather by treating the leather before dyeing with a salt of either antimony, titanium, tin, iron, or zinc. The salts of antimony and titanium are very useful for this purpose, the most useful being tartar emetic (antimony potassium tartrate), 'antimonine' (antimony lactate), potassium titanium oxalate, and titanium lactate.

§309. The fixing solution, when tartar emetic and salt is employed, is, as a general rule in the following proportions, for skivers, about 2 oz. of tartar emetic and 8 oz. of salt per dozen skins; for calf skins, 3 oz. of tartar emetic and 8 ozs. of salt per dozen skins. The solution in either case is diluted with sufficient water.

§310. The fixing is best done at a temperature of 30° to 40°C, (86° to 104° F.), and the goods require an immersion of from 10 to 15 minutes. Care must be taken to thoroughly soak the goods

in water, preferably by drumming, before fixing, in order to remove from them as much loose tanning matter as possible, and avoid waste of tartar emetic. The addition of salt to the fixing bath is to facilitate the precipitation of the antimony tannate.

§311. A more economical method of carrying out the fixing, is to keep a standing bath of tartar emetic and salt solution, and after the passage of a pack of goods through the solution, to strengthen up the liquor by the addition of tartar emetic before passing another pack through; and so using the solution over and over again, strengthening up for each fresh pack until the solution becomes too dirty to be further used with safety. Generally, a solution can be used for at least eight packs of goods before complete renewal is necessary.

§312. The fixing may be carried out in a large wooden tub or in a paddle, and the goods, when a tub is used, must be continuously stirred, with a wooden pole, just as is the custom when souring or clearing, (§124), or must be paddled for about ten minutes.

§313. After the goods have been fixed it is necessary that they should be well washed to free them from all soluble salts, for these would cause trouble in the subsequent dyeing, and tend to spue out of the goods when finished. Incompletely fixed salts of antimony or titanium moreover tend to a looseness of dye in the finished leather, lessening its power to resist rubbing, an important consideration when the goods are intended for upholstery purposes. Moreover when goods for hat-leathers are being treated, any loose antimony salt is liable to affect the skin of the wearer of the hat leather, in the direction of blood poisoning.

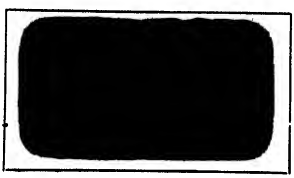
§314. When the standing fixing-bath is used, the bath will not require any further addition of salt. The continued use of a solution of tartar emetic results in the bath becoming acid, and in a gradual accumulation of acid potassium tartrate in the solution. This acidity must from time to time be neutralised by the addition of a small quantity of washing-soda solution, or, which is safer and less troublesome, by having a few pieces of broken marble at the bottom of the vessel containing the liquor.

§315. Salts of titanium (§308) are the more economical for fixing when yellows, browns, reds, yellowish greens, etc., are to be dyed.

§316. The titanium tannate formed when a vegetable tanned leather is treated with a solution of a titanium salt is of quite a heavy shade of yellowish brown, (tan brown). It is obvious therefore that when titanium salts are employed, a smaller quantity of dyestuff will be required when the goods eventually come to be dyed, especially when the shades to be dyed are browns.

§317. The fixing operation is not necessary for goods to be stained or brush dyed, when the dye solution is brushed on to the leather; as in this case the tannic acid has no opportunity of bleeding out.

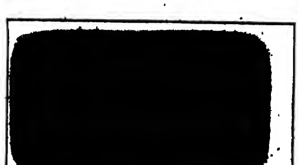
§318. Leather dyed with magenta.

(1.) 

(2.) 

(1.) Without previous fixing.

(2.) After previous fixing with tartar emetic.

(3.) 

(3.) After previous fixing with potassium titanium oxalate.

§319. Iron salts are often used by leather stainers, being either mixed with the dyestuff solution, or applied to the leather previous to staining, for the purpose of saddening the shade of the colour to be produced, the darkening being brought about by

the combination of the iron and the tannin, iron tannate being a black salt. It will be understood from what has been said above that this treatment with iron, though perhaps not altogether beneficial to the leather, (see Chapter VII.), has the effect of fixing any loose tannin there may be in the fibre of the leather. Leather stainers when staining with basic colours will have noticed that there is usually a less precipitation or curdling of the dye solution, on a leather previously 'bottomed' with a weak solution of some iron salt.

§320. Basic colours, especially when used at all strong, have a greater tendency to 'bronze,' (see pattern No. 2, page 123), than acid colours have (§330). The bronzing is a dichroic effect, produced by light reflected from the surface of the dyed leather. It is sometimes objectionable; the defect can be overcome, however, to a very considerable extent in the finishing of the leather.

§321. Most of the basic colours are precipitated when mixed with 'acid' dyes; on this account it is never to be recommended to dye with a mixture of the two classes of colour. If for any reason it is desirable to dye or stain goods with both an acid and a basic dye, it is always advisable to dye or stain with the acid colour first, and afterwards apply the basic dye, each colour, that is, being applied separately.

§322. A few of the principal basic colours met with in leather dyeing and staining are tabulated below.

BASIC COLOURS.

REDS.	**REDS.**
Acridine Red.	New Magenta.
Acridine Scarlet.	Rhodamine.
Aniline Scarlet.	Rhoduline Red.
Cerise, (Magenta).	Rubine, (Magenta).
Fuchsine, (Magenta).	Russian Red, (Magenta).
Grenadine.	Safranine.
Magenta.	Safranine Red.
Neutral Red.	Safranine Scarlet.

BASIC COLOURS.—(Continued.)

GREENS.

Benzal Green (Malachite Green).
Brilliant Green.
Capri Green.
China Green.
Diamond Green.
Emerald Green, (Brilliant Green).
Ethyl Green, (Brilliant Green).
Helvetia Green.

ORANGES & YELLOWS.

Acridine Orange.
Acridine Yellow T.
Auramine.
Aurophosphine.
Chrysoidine.
Coriphosphine.
Diamond Phosphine.
Flavophosphine.
Homo Phosphine.
Lavallière.
Leather Yellow.
Nanking.
New Phosphine.
Philadelphia Yellow.
Phosphine.
Rheonine.
Thioflavine.

BLACKS.

Corvoline.
Leather Black.
Vitoline Black.

GREENS.

Imperial Green, (Malachite Green).
Malachite Green.
Methyl Green.
Methylene Green.
New Fast Green.
Solid Green.
Victoria Green (Malachite Green).

BLUES.

Capri Blue.
China Blue.
Cotton Blue.
Cresyl Blue.
Methylene Blue.
New Blue.
New Metamine Blue.
Setocyanine.
Setopaline.
Victoria Blue.

VIOLETS.

Methyl Violet.
Neutral Violet.
Paris Violet, (Methyl Violet).
Regina Purple.

BROWNS.

Bismark Brown.
Canelle, (Bismark Brown).
Leather Brown.
Manchester Brown, (Bismark Brown).
Vesuvine, (Bismark Brown).

§323. The basic dyes are very fugitive to light, with one or two exceptions, as compared with the acid dyes. The exceptions are Rhodamine, Methylene Blue, New Blue, and Safranine.

§324. TESTING DYESTUFFS.—The fact that basic dyes are precipitated by tannin can be made a means of distinguishing acid colours from basic colours.

§325. A solution of convenient strength,—say $\frac{1}{32}$ to $\frac{1}{8}$ oz. dissolved in 1 pint water,—of the dye to be tested is made. The testing reagent is made by dissolving 3 oz. of tannic acid and 2 oz. sodium acetate in 1 pint water; or by dissolving 1 oz. of picric acid and 3 oz. sodium acetate in 2 pints water.

§326. A little of the dyestuff solution to be tested is placed in a clean glass vessel and a few drops of either of the above reagents are added. If a precipitate is formed the dyestuff is a basic one; if no precipitation takes place the dyestuff may be classed as an 'acid' colour.

§327. When thus testing dyes which make intensely dark coloured solutions, such as greens, blues, and violets, it is often difficult to tell whether the dyestuff has precipitated or not immediately on the addition of the reagent. In these cases it is better to allow the solution to stand for one or two hours when any precipitate will settle at the bottom of the vessel.

§328. The addition of sodium acetate to the testing solution is advisable, because the mineral acid of the colour salt (§301), if left free, would retard precipitation in the case of a basic dye. The sodium acetate combines with the liberated mineral acid.

§329. When a proper reagent, such as either of the two recommended above, is not at hand, a rough and ready test is to add to the dye solution a small quantity of a clear solution of some tanning extract, or of sumach.

Acid Colours.

§330. The acid colours are salts of organic colour-acids combined with an inorganic base, usually sodium. The term acid colour is simply indicative of the method of the application of the colour, and means that, when employing such a colour, acid is a necessary adjunct to the dyebath; it does not mean that the dyestuff itself is of an acid nature (§300). When applying an acid colour, the addition of a strong acid to the solution of the dyestuff is necessary in order to liberate the colour acid (sulphonic acid). Unlike the basic colours, the acid dyestuffs are not pre cipitated by tannin (§302), but this fact does not prevent their being valuable for use in dyeing vegetable-tanned leather; these colours having considerable attraction for the leather, which latter possesses the property of attracting acids, as well as bases.

§331. By the addition of acid to the dyebath, the maximum possible depth of shade is obtained. The acid of which it is most customary to make addition is sulphuric acid. But, as has been pointed out above (§156), even a minute quantity of this acid remaining in the leather eventually shows itself in serious damage done to the leather, and the hold taken upon leather by sulphuric acid is so strong that, once used upon it, no amount of washing with water will ever afterwards remove the acid.

§332. Formic, lactic, and acetic acids, have each of them been proposed as a substitute for sulphuric acid when dyeing leather with acid colours. The only organic acid, non-injurious to the leather, placed upon the market up to the present time, that will give a depth of shade in the finished leather at all comparable with that obtained when sulphuric acid has been employed, is formic acid. Lactic and acetic acids are of little value in this direction, the finished leather when either of these acids has been made use of in dyeing with an acid colour, is pale, lacking in brilliancy, and altogether unsatisfactory.

§333. The patterns here attached are of a leather dyed with Acid Green, (1.) without any addition of acid to the dyebath, (2.) with sulphuric acid added to the bath, (3.) with formic acid added.

§334. Leather dyed with Acid Green.

(1.)  (2.) 

(1.) Without addition of Acid. (2.) With Sulphuric Acid added to the bath.

(3.) 

(3.) With Formic Acid added to the bath.

§335. An addition to the dyebath much to be preferred to that of sulphuric acid, is the addition to it of sodium bi-sulphate. Sodium bi-sulphate is the product formed by the combination of sulphuric acid with sodium sulphate (Glauber's salt). And better results are obtained by the employment of the bi-sulphate direct than by acidifying the bath with sulphuric acid first of all and then adding sodium sulphate or *vice versa;* sodium sulphate and sulphuric acid do not readily combine in weak solution, the acid remaining in the free state, while it is liberated gradually when added in the form of sodium bi-sulphate.

§336. The action of sodium bi-sulphate upon leather is less energetic than that of sulphuric acid, and the addition of sulphuric acid in this form to the dyebath nullifies to a considerable extent the acid's injurious action on the leather fibre. The dyeing is to a perceptible degree slowed down and a more level result obtained, as the leather takes up the colour more evenly.

§337. The weight of acid dyestuff used in any given case decides the quantity of sulphuric acid necessary to be added to the dyebath in order to develop the full depth of shade; the quantity should be equal in weight to the weight of the dyestuff. If the dyeing is being carried out in the tray or paddle, this amount of sulphuric acid can be used without any danger of immediate or early injurious effect upon the leather. But if the dyebath is comparatively small, as when dyeing in the drum, the quantity of sulphuric acid added must be considerably reduced to prevent injury to the goods In no case should the dyebath have a greater strength of sulphuric acid than ¼ per cent. of the commercial acid (¼ lb., by weight, that is, to 10 gallons of the dyebath solution).

§338. When dyeing skivers with acid colours, in the tray say, the skins being medium size, and full shades being required, the quantities per 3 dozen skins should be, from 30 to 35 gallons of water, 9 oz. of dyestuff, and 9 oz., by weight (see Appendix D), of sulphuric acid.

§339. For paddle dyeing 10 dozen Persians with acid colour, rational quantities would be, 300 gallons of water, from 25 oz. to 30 oz. dyestuff, and from 25 oz. to 30 oz., by weight, of sulphuric acid.

§340. When dyeing in the drum, then in order to avoid wastage of dyestuff because of using too small an amount of sulphuric acid to liberate the full depth of shade, it is advisable not to use sulphuric acid at all, but to employ instead either formic acid or sodium bi-sulphate, as by this procedure all danger is obviated of injury to the goods. Proper quantities to produce full shades with acid colours when calf are being treated in the drum are, for 8 dozen medium-size skins, 4 lbs. dyestuff, 100 gallons water, and 4 lbs. of sodium bi-sulphate, or 6 lbs. of formic acid (40 %).

§341. The acid colours possess this advantage over basic colours, that they have not the tendency shown by the latter to dye a skin where the grain is defective a darker shade of colour than the grain surface which is in good condition; dyeing with acid colours gives a more level result.

§342. Taken as a class, the acid dyestuffs are much faster to light than the basic colours; they are also comparatively free from any tendency to bronze (§320).

§343. The acid dyes are not nearly so strong in colouring power as the basic dyestuffs. Chiefly because they have not the tendency just above referred to, of showing up bad grain, they are mostly preferred to the basic colours in this Country. Except for staining (brush dyeing), for which the basic colours are generally preferred.

§344. A plan to be recommended when the basic colours are used either for dyeing or staining is to first bottom the skins with a weak solution of an acid or 'direct' (*see* below) dyestuff, and afterwards top by dyeing or staining with the basic dyes. By following this method it will be found that the tendency to exaggerate defects that is possessed by the basic colours is to a large extent overcome. The defective portions of the leather surface, after their treatment by an acid or 'direct' dye apparently lose to an appreciable degree that attraction for the basic colour which they exhibit when there has been no acid colour bottoming.

§345. After dyeing with an acid colour and sulphuric acid the leather under treatment requires to be well washed in water to free it from excess of acid. The addition of a little acetate, lactate, tartrate, or citrate of soda or potash to the water used for the washing is advisable as it lessens the risk of ultimate decay of the leather. Sodium acetate (1 lb. to 100 gallons of water) is to be recommended. It must be borne in mind however, if such above addition is made to the water used in washing the leather, that this must again be washed in water so as to remove the slight amount of sodium or potassium sulphate formed, as otherwise these salts are apt to crystallize out on the dry leather and form a slight white deposit on the grain surface. Common salt may be used with advantage as an addition to the wash water in order to neutralise the evil effects of an excess of acid but here again the leather must be well washed free from salt otherwise there is a liability of the re-crystallization taking place

§346. *ACID COLOURS.*

REDS.

Acid Magenta.
Acid Maroon.
Acid Mauve.
Amaranth.
Apollo Red.
Archil Substitute.
Atlas Scarlet.
Azo Acid Carmine.
Azo Acid Magenta.
Azo Bordeaux.
Azo Cochineal.
Azo Crimson.
Azo Fuchsine.
Azo Rubine.
Biebrich Scarlet.
Bordeaux B., E Extra, Extra. [G.
Brilliant Cochineal.
Brilliant Crocein.
Cardinal Red.
Carmoisine.
Carnation.
Chromotrope.
Chromazone Red.
Clematine.
Cloth Red.
Crocein Red.
Crocein Scarlet.
Crystal Scarlet.
Erio Azurine.
Erio Carmine.
Erio Grenadine.
Erio Rubine.
Fast Acid Magenta.

REDS—*continued.*

Fast Red.
Fast Scarlet.
Grenadine.
Guinea Carmine.
Guinea Red.
Milling Red.
Milling Scarlet.
Napthol Red.
Orcellin.
Orchil Red.
Orchil Substitute.
Palatine Red.
Palatine Scarlet.
Paper Scarlet.
Ponceau.
Roccelline.
Scarlet.
Silk Scarlet.
Sultan Red.
Verv Red.
Victoria Scarlet.
Violamine.
Wool Scarlet.

ORANGES.

Aniline Orange.
Atlas Orange.
Crocein Orange.
Golden Orange.
Gold Orange.
Mandarine G Extra.
Orange I., II., III., IV., A, BB, ENZ, Extra, G, 2G, GS, GT, P,R,T,Y.

ACID COLOURS—continued.

YELLOWS.

Acid Phosphine.
Acid Yellow.
Azo Acid Yellow.
Azo Flavine.
Azo Phosphine.
Azo Yellow.
Canary Yellow.
Chinoline Yellow (Quinoline Yellow).
Chrysoine.
Citronine.
Crumpsall Yellow.
Cuba Yellow.
Curcumeine Extra.
Fast Yellow.
Indian Yellow.
Martius Yellow.
Metanil Yellow.
Milling Orange.
Milling Yellow.
Old Gold.
Picric Acid.
Quinoline Yellow.
Resorcine Yellow.
Solid Yellow.
Tartrazine.
Turmeric Substitute.
Turmeric Yellow.
Turmerine.
Yellow FYE, N.

GREENS.

Acid Green.
Cyanole Green.
Eriochlorine.
Erioglaucine.

GREENS—*continued.*

Fast Acid Green.
Fast Green.
Fast Light Green.
Guinea Green.
Light Green.
Milling Green.
Naphtol Green.
Neptune Green.
New Acid Green.
New Patent Blue.
Patent Blue.
Patent Green.
Parrot Green.

BLUES.

Acid Blue IV.
Alkali Blue.
Azo Acid Blue.
Bavarian Blue.
Biebrich Acid Blue
Blackley Blue.
Blue, I, II, III.
China Blue.
Coomassie Blue.
Cotton Blue.
Cyanole Extra.
Domingo Blue.
Disulphine Blue.
Eclipse Blue.
Eriocyanine.
Erio Marine Blue.
Fast Acid Blue.
Fast Blue.
Fast Marine Blue.
Fast Wool Blue.

ACID COLOURS—*continued.*

BLUES—*continued.*

Formyl Blue.
Fram Blue.
Glaucol.
Guernsey Blue.
Induline.
Lanacyl Blue.
Lazuline Blue.
Lussard Blue.
Marine Blue.
Napthamine Blue.
Napthol Blue.
Napthyl Blue.
New Patent Blue N.
New Victoria Black Blue.
New Victoria Blue.
Nigrosine.
Patent Blue.
Peacock Blue.
Pure Blue.
Pure Soluble Blue.
Silk Blue.
Solid Blue.
Soluble Blue.
Water Blue.
Wool Blue.

VIOLETS.

Acid Violet.
Azo Acid Violet.
Coomassie Violet.
Crystal Violet.
Fast Acid Violet.
Formyl Violet.
Guinea Violet.
Lanacyl Violet.
Napthyl Violet.

VIOLETS—*continued.*

Neutral Violet.
Regina Violet.
Victoria Violet.
Violamine.
Wool Violet.

BROWNS.

Acid Anthracene Brown.
Acid Brown.
Archil Brown.
Azo Acid Brown.
Bronze Acid Brown.
Cutch Brown.
Fast Brown.
Napthol Brown.
Napthylamine Brown.
Phenylene Brown.
Resorcine Brown.

GREYS.

Aniline Grey.
Coomassie Black.
Grey Bluish.
Grey Yellowish.
Nigrosine.

BLACKS.

Acid Black.
Acid Alizarine Blue Black.
Biebrich Acid Black.
Napthalene Black.
Napthol Black.
Napthol Blue Black.
Napthylamine Black.
Napthyl Blue Black.
Palatine Black.
Phenylamine Black.
Wool Black.

§347. Direct (Cotton) Dyes.—This heading comprises the numerous dyestuffs distinguished by the property they possess of dyeing cotton or other vegetable fibre without employing mordants. The first of these 'direct' dyes was discovered by Böttiger in 1884 and placed on the market under the name of Congo Red. These dyes are hence sometimes called Congo colours. If derivatives of benzidine, they are sometimes called the Benzidine colours.

§348. The direct dyes are usually sold as sodium salts of sulphonic acids, and are therefore similar in constitution to the acid colours.

§349. Many of these direct dyes are very suitable for leather, particularly so when level, pale shades of colour, those known as 'art' shades are required. They are best applied to the leather in neutral or slightly acid baths; formic or acetic acid being the most suitable acid. Many of the direct dyes produce full shades of colour on leather, when applied as ordinary acid colours with the customary addition of sulphuric or formic acid.

§350. A necessary addition to the dyebath when dyeing with direct colours, is some neutral salt, in order to assist in the better exhaustion of the dye from the bath. Sodium sulphate (Glauber's salt) or common salt are the most useful for this purpose. Four pounds of common salt, or sodium sulphate, per 30 gallons of dyebath being a suitable quantity. The goods after dyeing must be well washed in order to free them from the excess of salt.

§351. A few of the direct dyes are particularly suitable in dyeing chamois and oil-dressed leathers. Particulars of their application will be found in Chapter XXV, on the 'Dyeing of Oil-Dressed Leathers.'

§352. The following direct dyes are suitable for application to leather.

DIRECT COLOURS.

REDS.

Atlas Red.
Congo Corinth.
Diamine Red.
Dianthine.
Diphenyl Red.
Direct Red.
Erica.
Hessian Fast Red.

SCARLETS.

Diamine Scarlet.
Sultan Scarlet.

ORANGES.

Chicago Orange.
Chloramine.
Congo Orange.
Diamine Orange.
Direct Orange.
Mikado Orange.
Sultan Orange.

YELLOWS.

Chrysophenine.
Curcumein.
Diamine Fast Yellow
Diamine Gold.
Diphenyl Citronine.
Direct Yellow.
Fast Yellow for Cotton.
Hessian Yellow.
Mikado Gold Yellow.
Mikado Yellow.
Oxydiamine Yellow.
Polyphenyl Yellow.
Sun Yellow.
Triazol Yellow.

GREENS.

Azine Green.
Benzo Green.
Columbia Green.
Chlorazol Green.
Diamine Green.
Direct Green.

GREENS—*continued*.

Eboli Green.
Renol Green.
Sultan Green.

BLUES.

Brilliant Benzo Blue.
Chicago Blue.
Diamine Blue.
Diamine Grey Blue.
Diphenyl Blue.
Direct Indigo Blue.
Eboli Blue.
Napthamine Blue.
Napthyl Blue.
Renol Blue.

VIOLETS & MAROONS.

Chlorazol Violet.
Columbia Violet.
Diphenyl Violet.
Toluidine Blue.
Toluylene Blue.

BROWNS.

Chlorazol Brown.
Congo Brown.
Cotton Brown.
Diamine Brown.
Diamine Nitrazol Brown.
Diphenyl Brown.
Direct Brown.
Heliotrope, 2B.
Mikado Brown.
Pegu Brown.
Renol Brown.
Toluylene Brown.

BLACKS & GREYS.

Chrome Leather Black.
Diazine Black.
Direct Black.
Direct Blue Black.
Napthyl Blue Black.
Polyphenyl Black.
Renol Black.

§353. The basic dyes combine with the direct colours to form colour lakes. Hence many of the direct dyes may be used with advantage for bottoming goods that are to be eventually topped by dyeing or staining with basic dyestuffs. When this method of procedure is adopted, the topping should be done at a comparatively low temperature, 35° C. (95° F.); a higher temperature than this decomposes the lake which is formed. This bottoming with direct dyes and lightly topping with basic colours can be recommended when skivers for hat leathers, or upholstery leathers, are under treatment, as the power of the leather thus prepared to resist rubbing is increased.

§354. Eosines.—The application to leather of this group of dyestuffs is in neutral or weak acetic-acid solution. Chemically they are acid colours, but they are precipitated on the addition of a mineral acid (sulphuric or hydrochloric acid) to a solution of the dyestuff, and by admixture with many of the basic, and acid colours. On this account they are best applied singly, and not in admixture with either basic or acid dyestuffs. When for any reason admixture with any acid colour has to be made, then formic or acetic acid must be substituted for the customary addition of sulphuric acid.

§355. These dyestuffs are extremely fugitive to light, but owing to the purity of the pink shades they produce, they are still largely employed in the dyeing of fancy shades upon leather.

§356. The Eosines form lakes with lead salts and dye beautiful pink shades on leather that has been lead-bleached (§187). They are further useful in staining alum leathers, upon which they produce reddish shades, of great depth and beauty.

§357. The following are the principal Eosine colours:—

Cyanosine.	Methyl Phloxin.
Eosine.	Phloxin.
Erythrin.	Rose Bengal
Erythrosine.	Safrosin.

§358. THE SULPHUR OR SULPHIDE COLOURS.—These have come rapidly to the front during the past five or six years for use in the dyeing of cotton, for which purpose they are extremely important. Several patents have recently been granted for the application of these dyestuffs in the dyeing of leather, principally chrome leather.

§359. The sulphide dyes have usually to be dissolved in a weak solution of sodium sulphide; if they are soluble in water they contain sodium sulphide as a constituent of the dyestuff. Up to the present no really satisfactory method has been devised for applying these dyestuffs to leather, the alkaline solution of sodium sulphide having a most destructive action on the leather fibre, which the addition of formaldehyde to the dyebath (and this is the subject-matter for nearly all the patents in connection with sulphide dyes) does not really overcome.

§360. MORDANT DYES.—The mordant dyes are all of an acid character, and, as suggested by the name, they require a mordant (§441) to develop the colouring matter. It is when the leather dyer is dealing with chamois leather that the mordant dyes are chiefly of interest, though a few of them may be used for dyeing chrome and alum-dressed leather. One or two of them indeed may be satisfactorily applied to ordinary vegetable-tanned leather without any mordant at all.

§361. The mordant colours (which include the well-known Alizarine dyestuffs) are noted for their extreme fastness to light. The following are the principal mordant dyes of interest to the leather dyer. Those marked with an * will dye vegetable-tanned leather without any mordant.

* Acid Anthracene Brown.
Alizarine Black.
Alizarine Blue.
Alizarine Blue Black.
Alizarine Brown.
Alizarine Cyanin Black.
* Alizarine Cyanin Green.
Alizarine Orange.
Alizarine Sapphirole.
Anthracene Brown.
Brilliant Alizarine Cyanin.
Cœrulëin.
Domingo Chrome Brown.
Fustine.
Gallazin.
Gambine.
Gambine Yellow.
* Milling Brown.
* Napthol Green.

§362. Janus Dyes.—'Janus' is neither a chemical nor a scientific word, but is the name of an old Latin divinity represented with two faces looking opposite ways. The Janus dyes are dual in their nature; they possess both acid-dye and basic-dye peculiarities; can be applied in either acid or neutral solutions; and they are precipitated by tannin. So far as leather is concerned it is best to regard them as basic colours (§301), to first fix the leather with antimony (§308), and to apply the dye in a bath slightly acidified with acetic or formic acid.

The Janus dyes suitable for leather are these:—

Janus Red.	Janus Brown.
„ Claret.	„ Green.
„ Yellow R.	„ Blue.

§363. Fat Colours.—These colours are fatty compounds of colour bases, which are principally employed in colouring fats, waxes (candles), oil varnishes, soaps, &c. They are oleates or stearates of their colour bases, and are prepared by adding oleic or stearic acid to the bases. Or they can be prepared by precipitating an aqueous solution of a basic dye with a soap solution. They are insoluble in water, but dissolve readily in benzene.

§364. The fat colours are but of limited application to leather, but can be used in staining it. Dissolved in benzene, the solution can be employed for staining greasy leather.

§365. These colours, with an exception or two, are extremely fugitive to light. This fact, together with that of the expense of the benzene required as a solvent, limits their use. Except indeed for very special purposes; as, for example, additions to grease finishes, polishes, shoe dressings, &c.

Dissolving Coal-Tar Dyestuffs.

§366. The dissolving of these dyestuffs requires extreme care. Want of full attention to this seemingly simple operation of dissolving is in many cases responsible for faulty dyeing and faulty staining.

§367. The dissolving should be carried out in a wooden vessel, and, for the acid and direct dyes, *boiling* water should be added to the dyestuff and the mixture should be continuously stirred during the addition, the addition of boiling water and the stirring being continued until all the dye has gone into solution. For basic dyestuffs the water should not be boiling, but should be at a temperature of from 80° C. to 85° C., (176° F. to 185° F.), as some of the basic colours undergo decomposition at boiling-water temperature.

§368. The plan in vogue amongst leather dyers, of placing the dyestuff in cold or warm water and blowing live steam into the mixture until the colour is dissolved should never be practised with the basic dyes because of the decomposition that takes place on boiling. For example, Auramine loses much of its colouring power on boiling. The plan of dissolving dyestuffs in a metal bucket over a gas fire is also to be condemned.

§369. The water employed for dissolving dyestuffs should as far as possible be free from carbonates of lime and magnesia (temporary hardness), as these tend to bring about precipitation of the dyestuff; especially is this so with basic dyes. If the water to be used has temporary hardness this must be neutralised by the addition of acetic, or formic, or lactic acid, the addition being continued until a piece of blue litmus paper when placed in the solution turns slightly pink in colour.

§370. Condensed water from steam pipes or boiler is to be recommended for the dissolving of dyestuffs, if such water is available, which it usually is in modern leather-dressing works. Care, however, must be taken to ascertain if this water is free from contamination with iron.

§371. For the dissolving of acid colours, hard water is not nearly so objectionable as for the dissolving of basic colours. The acid added to the dyebath when acid colours are in employment, is in general sufficient in quantity to decompose the lime-lake (precipitate) which may be formed.

§372. The dyestuff solution should be filtered after preparation in the case of those of the basic colours, many of them that is to say, which do not dissolve to a perfectly clear solution. A dye solution which has not been filtered and contains insoluble particles should never be used, as the insoluble particles are apt to be deposited upon the leather in the dyebath and to give rise to spots and streaks. When an unfiltered solution is used for staining, the liability of damage to the leather from these particles is much greater than when the leather is being dyed.

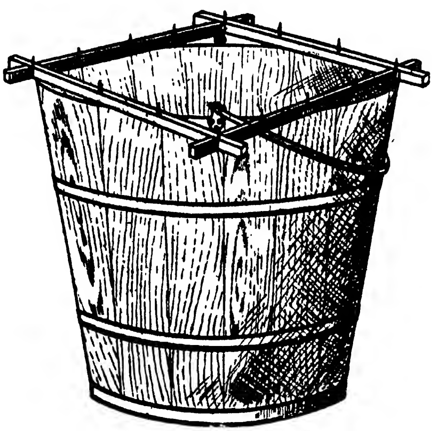


Fig. 84.

§373. The filtration is easy, and the only apparatus necessary is a rectangular wooden frame, (Fig. 84), round the outer sides of which a number of small copper nails or hooks have been driven. A piece of canvas slightly larger than the frame, well washed out in hot water, goes over the frame, and is kept in place by the projecting nails or hooks. The frame thus provided with canvas, is placed over the dye-tray or over a wooden bucket or other convenient vessel, and the dyestuff solution is poured through the canvas. A convenient size for the frame is about 14 inches by 12 inches, as a frame of these dimensions will rest conveniently on an ordinary 3 gallon wooden bucket.

§374. The filtering is comparatively costless, as the half-dozen or so pieces of canvas that are required for the different coloured dyestuffs can be washed out after use and used over and over again. Still it is inadvisable to employ a piece of canvas that has been used several times in filtering green-dye solutions, for filtering say red-dye solutions. A discrimination must be exercised despite the washing out of the canvases. Dyestuff solutions that are to be used for staining, 'flaming,' or topping, should invariably be filtered.

§375. Wooden vessels are to be preferred for making dyestuff solutions, but there is no objection to the use of copper or tin vessels for the purpose if the water used has not been acidified.

§376. Many of the basic colours, notably Methyl Violet, are somewhat difficult to dissolve in water. With such colours the dyestuff should first be made up into a paste with a strong solution of acetic or formic acid; a solution of half acid, (the commercial acid), and half water,.and the dyestuff solution then made from the paste by the addition of hot water, in the manner described above, (§367). An alternative plan is to dissolve the dyestuff in a little methylated spirit afterwards diluting with plain water.

§377. The acid dyes require from 15 to 20 times their own weight of boiling water (§367) to thoroughly dissolve them; that is, from 5 lbs. to 6½ lbs. of dye will require about 10 gallons of boiling water. The basic dyes are less soluble, needing from 20 to 40 times their own weight of hot water to complete their dissolution; that is, from 2½ lbs. to 5 lbs. of dyestuff will require the above-named quantity of water,—10 gallons.

§378. Most dyestuffs dissolve readily in alcohol or methylated spirit, and in acetic acid. Glycerine also is a useful solvent for many of the coal-tar dyestuffs.

§379. Impurities of Coal-Tar Dyestuffs. — The chief impurities of the coal-tar dyes are either dextrine, sodium sulphate, common salt, or other harmless substance, and the addition of such ingredients is not necessarily adultera-

tion. In manufacturing coal-tar colours, because of the practical difficulty of not being able to manufacture with certainty two different batches of the same dyestuff, of exactly the same strength, it is necessary to work to a predetermined standard, and consequently to sometimes dilute the manufactured colour by one or other of the above substances. In this way the consumer obtains his dyestuff of always one definite strength. Moreover, the colouring power of many of the dyestuffs as manufactured, is extreme. Their colouring power is such in fact that the weighing out would have to be in troublesomely small quantities and would require inordinate care. Hence before these colours come into the market, the manufacturer, by the addition of dextrine or other harmless ingredient, reduces their colouring power to half or quarter or so strength.

§380. On the other hand, it is very necessary to point out that, owing to the competition amongst manufacturers, dyestuffs are often so extremely diluted that many of them do not contain more than 5 % of actual colouring matter. The only practical method of testing the strength of any particular sample of dyestuff is by comparative dye trials.

§381. Mixed Dyestuffs.—A large number of the dyestuffs offered to the leather dyer by the various coal-tar colour manufacturers and others, are simply mechanical mixtures of two or more single colours. One particular dyestuff that could be pointed out by the author is a mixture of no less than six distinctive colours. Mixtures of dyes in powder form are not generally to be recommended. Very much faulty dyeing and staining is brought about by such mixtures. Some dyestuffs are of harder nature than others, and thus when two or more dyestuffs of differing hardness are ground up together, the ground particles vary in their degrees of fineness, and when such a dyestuff stands for some time in a keg or other receptacle, the heavier particles settle to the bottom of the vessel, just as particles of lead would settle if mixed with flour. Consequently the colour of each pack of goods dyed with the dyestuff will vary according to the amount of the settlement,

unless indeed precautions are taken to frequently remix, which is neither convenient nor satisfactory.

§382. The dyer should as far as possible always make his own mixtures; not of the dyestuffs, but of the dyestuffs *in solution*; making his solution of the dyestuffs singly, and mixing as required to produce the particular shade he desires.

§383. The dye manufacturer often makes a mixture *of solutions* of two colouring matters, and evaporates to obtain his new dyestuff. A dyestuff thus produced is of course not open to the objection just mentioned that attaches to mechanical mixtures of dyestuffs.

§384. Dyestuffs that have been produced by mixture of single-colour dyestuffs can be recognised by one or other of the following methods:—

(1.) A small quantity of the dyestuff to be tested is placed on the point of a knife, and then blown for some little distance on to a piece of white blotting paper previously moistened with water. The particles of the dyestuffs will dissolve on the blotting paper, and each particular particle will show a spot of the colour proper to it.

(2.) If the dyestuff to be tested is blown from the point of the knife on to the surface of a small quantity of concentrated vitriol contained in a porcelain basin, so that the dyestuff particles are acted upon by the acid, then differences of colour in the particles will show themselves, and thus indicate mechanical mixture. If the tested dyestuff happens to be a mechanical mixture of two dyestuffs similar in shade, as for example, orange and red, the latter of the methods here given is preferable to the former; the acid acting upon the dyestuff will invariably produce a different shade of colour with each of the small particles of the dyestuffs.

CHAPTER VI.

Natural Dyestuffs.

Logwood.

§386. Logwood was introduced into Europe by the Spaniards shortly after the discovery of America. It is undoubtedly to-day the most important of the natural dyestuffs, being practically the only natural colouring matter that has not been entirely superseded by the artificial coal-tar dyestuffs.

§387. Logwood, or, as it is sometimes called, Campeachy Wood, having been originally exported from the Bay of Campeachy, is now principally obtained from British Honduras and Jamaica.

§388. The colour producing principle in logwood is known as hæmatoxylin. Hæmatein, the colouring matter of logwood, is produced during the 'ageing' process of the wood by the oxidation of the hæmatoxylin.

§389. The 'ageing' of logwood is carried out by exposing slightly damp chipped logwood, in pile, to the action of the air for several weeks, until the colour of the wood has changed from the light yellowish brown of the fresh wood, to a rich reddish brown.

§390. Logwood extract, owing to its convenience for use, is gradually taking the place of the solid wood. The extract is prepared on a large manufacturing scale by extracting under steam pressure the colouring principle from the wood, usually from wood that has not been 'aged,' and afterwards by evaporation in vacuo, concentrating the liquor thus obtained. The extract is sold either in the form of a concentrated solution, of about 50° Twaddle, as Logwood Extract, or in solid form as Solid Logwood Extract, or is crystallized or ground, when it is known as Logwood Crystals.

§391. Extract of Logwood, prepared by special processes, by different manufacturers, is on the market under several names, of which the principal are Hæmatein, Hemol, Hematine, and Hemolin.

§392. The extracts vary considerably in the amount of available colouring matter present. Many of the cheaper extracts are largely adulterated with such materials as glucose, dextrine, tannin extracts, salt, sodium sulphate, &c. When buying logwood extract in large quantity it is desirable to have an analysis and colour dye trial made of a sample of the extract.

§393. In using the solid wood, which is sold in chips, it is necessary to extract the colouring matter by boiling. There are many convenient forms of extractor on the market that can be utilised for this purpose. A common plan is to place the dyewood in a bag in a copper vessel, which can be easily heated; and boil up with a sufficient amount of water for 30 to 40 minutes. One boiling is not sufficient to exhaust the colouring matter from the wood: it is economical therefore to boil up with three or four successive quantities of water.

§394. Another plan is to place the chips in bags, and steep the bags in water in a wooden vat; then to blow steam into the water until it boils, and to continue the boiling for twenty minutes. After the boiling the liquor is drawn off from the vat, and the logwood by a second boiling with another lot of water is still further exhausted of its colouring matter.

§395. One cwt. of logwood chips will make about 40 gallons of dye-liquor suitable for use in blacking.

§396. It is the custom in leather dyehouses when exhausting logwood chips, to add washing soda or other alkali to the water used in the extraction. This plan, owing to its resulting in a darker coloured liquor, would lead one to imagine that more colouring matter was being extracted than by the process just described. This is not the case however. The boiling with weak alkali causes much of the colouring matter to be precipitated,

The logwood is best extracted with plain water, alkali if necessary (§399), being afterwards added to the decoction.

§397. Logwood is a mordant dyestuff, producing with an alum mordant a violet colour; with iron a bluish black; with chrome a deep blue; and with copper a greenish blue.

§398. Application of Logwood.—In employing logwood for the production of blacks on leather, it is customary to apply the logwood infusion first to the leather, and the mordant afterwards.

§399. The most important use in connection with leather to which logwood is put, is in the dyeing of blacks in conjunction with an iron mordant. For brush dyeing or staining, a strong infusion of the logwood or logwood extract is employed, previously made slightly alkaline with ammonia or sodium carbonate, in order to increase the dyeing power and to assist in 'cutting' the grease in the case of greasy leather. Another function of the alkali is to prevent the logwood infusion from striking through, that is from penetrating the leather. The alkali is not so important when the logwood is used for dyeing blacks in the bath.

§400. From the leather-dressers' standpoint the paramount use of logwood is in the staining of blacks on vegetable-tanned leather, and the dyeing of blacks on chrome-tanned and alum-dressed leathers. When using logwood for blacking goods, in conjunction with some iron salt, a suitable strength of solution is 3 lbs. logwood extract, with 4 oz. fustic extract, dissolved in 10 gallons of water, to which is afterwards added 2 oz. of washing soda. This logwood-fustic solution is first applied, and then the solution of iron. For the iron solution, with the commonest class of goods, 'Copperas' (ferrous-sulphate) (§444) is made use of. Nitrate of iron (§445) or iron acetate (§447) is employed for better quality goods. 5 lbs. copperas, and ½ lb. copper sulphate or acetate, (§403), per 10 gallons of water makes a solution of convenient strength.

§401. In staining blacks it is very necessary that plenty of the logwood infusion should be applied to the leather, especially if

this is at all lightly tanned. Unless there is plenty of tannin and colouring matter to unite with the iron, the iron will combine with what there is of tannin matter in the leather, and render it brittle and liable to crack (§443). If too much iron is used the leather may be completely ruined. The writer has seen many cases where leather has been rendered brittle by too little logwood and too much iron.

§402. As logwood gives bluish or violet blacks, it is necessary, when a jet black is required, to add a yellow or brown colouring matter to tone off the blue. Fustic, sumach, quercitron bark, galls, etc., are often used for the toning off.

§403. Copper mordants with logwood give very deep bluish blacks, which are faster to light than the violet blacks produced with logwood and iron. The use of a little copper sulphate or copper acetate together with the iron in dyeing blacks is useful, as helping to produce a black which is fast to light. Brazil Wood extract may be added to the logwood decoction in order to improve the fastness to light of the black.

§404. A neutral or a weak acid-solution of logwood is of much value as a bottom in staining or dyeing, sufficient acetic or formic acid being added to the solution to change its colour to a yellowish brown. Usually from 1 oz. to 2 oz. (liquid) of acetic or formic acid per 1 lb. of extract will be sufficient.

§405. A solution of 4 oz. logwood extract, and 1 oz. of acetic or formic acid in 1 gallon of water makes a suitable solution to use as a bottom previous to staining with the coal-tar dyes. The same solution used wholly as a stain, produces a nice shade of 'natural' colour in hides, etc., for bag or case work. Mixed with a little Indian Yellow, Azo Flavine, or other yellow dyestuff, a variety of shades can be produced that are noted for their softness. The well-known 'London colour' can be produced very cheaply in this way.

§406. The neutral or weak acid-solution of logwood can be economically employed for dyeing russet shades on Persians or Bagdad sheep to be dressed for linings, &c.

Fustic.

§407. This dyestuff, which also goes under the names of old fustic, Cuba wood, and yellow wood, is the wood of a tree botanically known as *morus tinctoria* or *maclura tinctoria*, which is found in Mexico, Brazil, and the West Indies; the best qualities come from Cuba. This natural dyestuff, which is perhaps next to logwood in importance to the leather dyer, is used in various forms, such as the chipped wood, paste extract, or solid extract; it is extensively used as an addition to a logwood infusion when dyeing or staining blacks.

§408. With the ordinary mordants fustic gives colours as follows:-

Mordant.	*Colour.*
Alumina	Yellow.
Iron	Olive Green.
Copper	Olive Green.
Chromium	Greenish Yellow.
Tin	Orange Yellow.

§409. A good yellow on leather can be produced by first mordanting with a solution of alumina sulphate or alum and then dyeing with an extract of the dyestuff. This yellow stands light fairly well, though on long exposure it assumes a slightly brown colour. Since the advent of chrome leather, fustic has been largely employed in the dyeing of it. The fustic is usually applied in admixture with gambier, as a ground or bottom colour, when dyeing browns; the leather being afterwards dyed with the coal-tar dyestuffs. In ordinary work of leather dyeing, such coal-tar colours as Azo Flavine, Tartrazine, Indian Yellows, Napthol Yellows, &c., have largely taken the place of fustic.

Brazil Wood, Peach Wood, Lima Wood, Sapan Wood, Pernambuco Wood.

§410. The above, which include the whole of the red woods, are allied to each other botanically. Their dyeing properties, one and all, are very similar, and they apparently contain the same

colouring matter (*Brazilein*). The woods and extracts prepared from them are sold indiscriminately under the names, usually, of Peachwood or Brazil wood.

§411. The woods previous to the making of extracts from them, are subjected to the 'ageing' process described in respect to logwood (§389).

§412. These woods produce red shades with an alum mordant and reddish violet shades with chrome. They are still used by the leather dyer in small quantities, especially upon skivers. They may be used economically for bottoming when reds, maroons, etc., are to be dyed; bottoming in a solution of the wood extract, and adding a little alum to the dyebath previous to dyeing with the coal-tar dyestuff.

§413. When dyeing reds on alum leather, peachwood may be used for bottoming with advantage; also when red or 'ox-blood' shades are to be produced on chrome leather.

Cochineal.

§414. Cochineal is a dried insect which lives on certain species of cactus, both the insect and the plant being natives of Mexico. On leather, with a tin mordant, cochineal produces a bright scarlet; with alum a crimson is obtained.

§415. The cochineal scarlet is of greatest importance so far as leather is concerned, the scarlet produced by it being more brilliant than any of the coal-tar scarlets, and also faster to light than most of the coal-tar scarlets.

§416. In the dyeing of a scarlet with cochineal upon a vegetable-tanned leather it is usual to apply the dyestuff and mordant both in the same bath, the mordant, usually stannous chloride (tin crystals), slightly acidified with hydrochloric acid, being boiled with the dye before this is added to the dyebath. When very brilliant shades of scarlet are to be produced, a small quantity of yellow colouring matter, as well as the cochineal, is necessary, fustic being the yellow to be preferred.

§417. A working recipe for cochineal dyeing is 2 lbs. cochineal, ½ lb. stannous chloride, and 1 lb. tartar (potassium bitartrate). The dyeing should be carried out at a low temperature, (35° to 40°C), otherwise there is liability of injury to the leather.

Turmeric.

§418. Turmeric, which is a dyestuff still used by many of the old-fashioned leather dyers, is obtained from the roots of a plant found growing in the East Indies and China, known botanically as *Curcuma tinctoria*. This dyestuff is generally used in the ground form, and is of a bright yellowish-orange colour. It is as a rule applied to leather in simple solution, without any addition to the dye-bath, but a little alum or acid may be added with advantage. The colour produced is a yellowish brown, which is exceedingly fugitive to light, and is also easily affected with alkalies, which make the shade a reddish brown. If the dye-bath is in the slightest degree alkaline when turmeric is being used, no dyeing takes place. Turmeric is still used for dyeing alum kid.

Persian Berries.

§419. Persian berries produce with the mordants somewhat similar shades to those obtained with fustic and the various mordants. The berries are more expensive than fustic, and contain less colouring matter, and they are very seldom used in the dyeing of leather.

Saffron.

§420. This is obtained from the pistils and stigmata of the flower *Crocus Sativus*. It was once largely employed in both leather dyeing and leather staining, for producing the 'saffron shade.' But owing to its cost and because the shade produced can be easily obtained by many of the coal-tar dyestuffs, it has almost entirely gone out of use.

Orchil or Cudbear.

§421. Orchil liquor is prepared by treating a certain species of the lichens to an oxidation process in the presence of ammonia, when a reddish-violet coloured liquor is obtained. Cudbear is obtained by evaporating orchil liquor to dryness, the product being then ground and powdered.

§422. In using orchil or cudbear no mordant is required, the colouring matter being substantive, and possessing the property of dyeing in either an acid, alkaline, or neutral bath. It is preferable when using this dyestuff to dye in a neutral bath; the dyeing proceeds rather slowly, but with great regularity and evenness, and gives a bluish maroon shade. With the exception of logwood, this dyestuff is perhaps used to a much greater extent by leather dyers and finishers than any of the other natural colouring matters. It is chiefly used for the dyeing of furniture maroons, and there is the popular prejudice in its favour that it is much faster to light than the aniline colours. But this idea is prejudice only, as many of the aniline dyestuffs are much faster to light than this comparatively fugitive dyestuff. Orchil liquor is used to a very large extent for topping maroons in the finishing shop, being applied in fairly concentrated solution with a brush. The only advantage that can be claimed for the use of orchil liquor for this purpose, is that it combines well with the leather and is fairly fast to rubbing. It is, however, very expensive when compared with the aniline dyestuffs, and the disadvantage that the latter possess, of being loose to rubbing, is easily overcome by the use of a waterproof finish.

Acacia Catechu or Cutch.

§423. Cutch is a solid extract made by boiling the twigs and leaves of a species of acacia, native to India. Cutch is imported into England in dark irregular blocks of about 100 lbs. in weight each.

§424. This dyestuff is especially useful to leather dyers and stainers, in that it dyes leather a pale brown colour without the use of any mordant, and makes an exceedingly good ground colour to begin with, when dyeing browns with the coal-tar colours. A method which the writer has found to give very good results is to treat the goods for about half an hour in the drum with a 2 to 3 per cent. solution of the cutch (2 to 3 lbs. per 10-gallon dye-bath) at a temperature of from 45° to 50° C; and when the leather has attained a light yellowish brown colour, to add the dissolved

acid dyestuff, and let the dyeing proceed till the desired depth of shade is obtained. It will be found that this method means considerable economy in the coal-tar dyestuff; moreover the shades produced are of a much richer and fuller character than if the cutch had not been employed. Two-thirds of the amount of coal-tar dyestuff usually employed to produce the same depth of shade will usually be found sufficient if the dyeing has been started with the cutch bottom.

§425. The shades produced may be saddened without detrimental effect upon the leather, by the addition of small quantities of potassium bichromate, or a salt of iron, when cutch has been employed for a bottom.

§426. Cutch may also be employed with advantage as a substitute for logwood in the production of blacks. A method to be recommended when staining blacks on leather, is as follows:—5 lbs. of cutch is dissolved by means of steam in from 10 to 20 gallons of water; when all the cutch is dissolved, from 2 to 3 lbs. of washing soda is added, and the steaming is continued until the soda has gone into solution. The quantity of soda required depends upon the greasiness of the leather that is being stained. The solution is applied to the leather with a brush, as in the case of logwood, and followed by the application of an iron solution. It will be found that this procedure produces deep dead blacks, blacks which are faster to light than the bluish blacks produced by logwood and iron.

§427. As cutch contains upwards of 60 per cent. of tannin matter, it may be substituted either partially or wholly, with advantage, when heavy shades of colour are to be produced, for the sumach retannage (§128) usual before dyeing.

§428. EBONY CHIPS.—The green wood, ebony, is still employed to a limited extent in leather dyeing, in conjunction with other natural dyestuffs; especially in the dyeing of furniture leathers. It is generally employed without any mordant, producing pale shades of greenish black. The material however is really of very little value.

Indigo.

§429. Blues, indigo-dyed, are still prepared by one or two firms especially for bookbinding leathers.

§430. Indigo comes into commerce in the form of dark blue or purplish masses, which break with a conchoidal fracture. Though insoluble in water, indigo possesses the property, under the action of reducing agents, (compounds capable of giving up nascent hydrogen, or of assimilating oxygen), of convertibility into Indigo White, which is soluble in weakly alkaline solutions.

§431. By immersion of the leather or other material to be treated in a solution of indigo white, and afterwards exposing the material to the action of the air, the indigo white becomes oxidised on the fibre, and the indigo blue (indigotin), fixed on the fibre results. By this treatment of the material a permanent blue colour is obtained. The method is called the indigo-vat method.

§432. In the vat-dyeing of indigo blues on textile fabrics there are several different methods of procedure, namely the copperas vat, the zinc vat, and the hydrosulphite vat methods. In the dyeing of leather with indigo the copperas vat is that which is usually employed. The leather to be treated is placed in a wooden or stone vat containing a mixture of water, indigo, ferrous sulphate and lime. The indigo, first powdered and ground up with water to a fine paste, and the ferrous sulphate, (previously dissolved), are placed in the vat, and the water and milk of lime are then added. The liquor should be of a yellowish or brownish amber colour before the goods are immersed.

§433. The quantities of the ingredients for the vat vary according to the shade of blue required, but the following may be taken as general when making up a fresh vat, viz.:—

Indigo	1 lb.
Ferrous Sulphate	2½ lbs.
Lime (Slaked)	3 lbs.
Water	50 galls.

The mixture should be allowed to stand for a period of at least 24 hours before entering the goods, and the vat is commonly used

over and over again, until it becomes too dirty for further use, additions of lime and ferrous sulphate being made as required.

§434. The goods, after immersion in the vat for several hours, are removed, rinsed in a weak solution of sulphuric acid, (formic or acetic acid is preferable), to remove the lime salts deposited on the leather, and are then hung up exposed to the air so as to allow the oxidation of the colour to take place. The operation is repeated until the required depth of colour has been obtained.

§435. With the zinc vat indigo-dyeing, the following are average quantities of material:—

Indigo	... ...	2 lbs.
Zinc Powder	... ...	2 lbs.
Lime (Slaked)	... ...	3 lbs.
Water	... ...	50 galls.

§436. With the hydrosulphite vat the reducing agent is hydrosulphurous acid (§205). This is undoubtedly the best vat for the dyeing of leather with indigo. Of indigo 1 lb., and of slaked lime 2 lbs., are boiled in about 10 gallons of water; 2 lbs. of sodium hydrosulphite (§209), or 2 gallons of hydrosulphite solution (§207), is then added, and the mixture is heated for from half an hour to one hour. Then the mixture is diluted to 50 gallons, and from 1 lb. to 2 lbs. of sodium hydrosulphite are added before immersion of the goods.

§437. If during use the liquor becomes oxidised, which is denoted by its change of colour, hydrosulphite is added until the yellowish brown colour is restored. Also when using a vat over and over again, the alkalinity increases considerably, and it is therefore advisable from time to time to neutralise this by the addition of small quantities of dilute sulphuric acid.

§438. Indigo Extract.—Is prepared by acting upon Indigo with concentrated sulphuric acid; 1lb. of Indigo being added to about 5lbs. of concentrated acid. By this treatment (sulphonation) the Indigo becomes soluble in water. A solution of Indigo extract is sometimes known as 'Saxon' or 'Saxony Blue.'

Indigo extract which should dissolve in water without depositing any sediment is still used for dyeing and staining blues on leather, and for this purpose is economical.

§439. Indigo Carmine is a better quality indigo extract being prepared from refined indigo, and the excess of sulphuric acid used in the making has been carefully neutralised. Indigo Extract is applied to leather in the same manner as an acid colour (§330), and may be advantageously used as a bottom when dyeing or staining dark blues.

ANNATTO.

§440. Annatto is the pulpy part of the seeds of *Bira orellana;* it is imported to this country from Cayenne and Martinique in the form of a pulpy mass or as dry cakes. Annatto is a very useful dyestuff for use in staining pale shades e.g. London colour, on leather, the shade produced being exceedingly level in colour. The colour produced by annatto may be modified as required by mixing with small proportions of any suitable acid dyestuff. Annatto is cheap, and moreover is easily procurable in almost any quantity; it may be used with advantage in dyeing pale shades of 'Self' or Tan colour, or as a bottom.

CHAPTER VII.

MORDANTS.

§441. Mordants are substances which wholly or partly combine with the colouring matter of dyestuffs to form definite compounds on the fibre of the material under treatment. In most cases the mordant is an essential constituent of the colour produced, as without the mordant no colour, or at most a worthless shade of colour is the result on application of the dyestuff.

§442. The mordants may be divided into two distinct classes (a) metallic mordants, (b) tannin mordants. The former are essential when dyeing with mordant dyes; are essential with the greater proportion of the natural dyestuffs, that is to say; as these for the most part are useless without mordants. The tannin mordants are employed with the basic artificial organic dyestuffs. The metallic mordants used in leather dyeing are chiefly iron, aluminium, antimony, copper, titanium and chromium. Vegetable tanned leather is already mordanted with tannin; alum-dressed leather with aluminium, and chrome-tanned leather with chromium; the 'leathering,' tanning that is to say, or making into leather, being produced by the action of the metallic-salt mordants on the hide fibre in the case of the mineral (alum and chrome) tanned leathers, and by the action of tannin in the case of vegetable-tanned leathers.

IRON.

§443. Iron is without doubt the most important of the mordants used in dyeing or staining leather, it being almost universal to use iron as a mordant with logwood for the production of blacks. The salts of iron occur in two states of oxidation viz., as ferrous and ferric salts. Only ferric salts give blacks with logwood, but the employment of ferrous salts is advantageous, for the ferrous salts become oxidised by the oxygen in the air

into ferric salts, and as this oxidation is comparatively gradual, there is sufficient time for the salts to combine with the colouring matter of the logwood before complete oxidation takes place, and the black is thus actually oxidised on the fibre of the leather. Ferrous salts give a much bluer black on leather with logwood than do ferric salts; the latter give a somewhat better black, as they strike the black at once. When ferric salts come into contact with organic matter they oxidise it, and are themselves reduced to the ferrous state. When an insufficient amount of logwood infusion is applied to the leather previous to the application of the iron solution, the latter will attack the tannin in the leather, and will oxidise it, acting thus destructively upon the leather and causing it to become brittle and tender. It is therefore of the utmost importance when staining or dyeing logwood-iron blacks, that a sufficiency of logwood should be applied to the leather for the iron to combine with, so that there may be no liability of the oxidising action of the iron salts taking place at the expense of the tannin in the leather.

§444. Ferrous Sulphate, Copperas, Green Vitriol, or Sulphate of Iron.—This salt is commercially known under the above several names, and is a cheap salt. The fact of its being a bye product in many chemical manufactories accounts for its cheapness. It can further be readily made, by dissolving scraps of iron in dilute sulphuric acid. It is soluble in water, to the extent of 7 lbs. in 10 gallons. The only advantage of this salt is its cheapness, for it has the disadvantage that in combination with the colouring matter of the logwood, it liberates sulphuric acid, and if an insufficient amount of soda or ammonia has been added to the logwood infusion to neutralise this sulphuric acid the effect on the fibre of the leather is very detrimental. Of preference some salt of iron should always be used, which, when the iron combines with the colouring matter of the logwood, liberates a volatile acid, for example, acetic acid, an acid which has no injurious effect on the leather.

§445. Nitrate of Iron, as it is commonly called, is neither ferric nor ferrous nitrate; the name is a misnomer. It is usually

prepared by treating a solution of ferrous sulphate with a mixture of nitric and sulphuric acids, and consists of ferric sulphate, ferric sulphate nitrate, and basic ferric sulphate nitrate. The form in which it is commonly sold is that of a solution of about 80° Tw. strength. Nitrate of iron has been used to a very large extent for dyeing blacks with logwood on chrome leather, for which purpose it seems to possess some advantages over other forms of iron, the black produced being much deeper and bluer.

§446. As sold to the dyer, the solution is exceedingly acid. Nitrate of iron can be prepared according to Meyret, by taking 72 parts of ferrous sulphate and a mixture of $6\frac{1}{2}$ parts of sulphuric acid (168° Tw.), with $12\frac{1}{2}$ parts of nitric acid (67° Tw.), diluted with a little water. The mixed acids are gradually added to the ferrous sulphate, and when reaction ceases the mass is heated by blowing in steam. The preparation of the salt should be in the open air, or means should be provided for carrying off the nitrous acid fumes evolved, this gas being poisonous.

§447. Ferrous Acetate, Iron Liquor, Pyrolignite of Iron, or Black Liquor.—This salt of iron, usually sold in solution, of about 20° to 30° Tw. strength, has a dark greenish brown colour. It is made by dissolving scrap-iron in crude acetic acid, or as it is called pyroligneous acid. Iron liquor is simply a solution of impure ferrous acetate; it also contains catechol and allied derivatives, coming from the tarry matter of the crude acetic acid. These included substances have the effect of making the solution keep; pure ferrous acetate oxidises very rapidly. They also impart a greenish black colour to the liquor.

§448. This solution of iron is an exceedingly safe one to use, owing to the fact that when iron combines with the colouring matter of logwood, acetic acid is liberated which, being volatile, has no detrimental effect on the leather fibre. Leather blackened with the help of this salt possesses a rather peculiar pungent smell, which comes from the tarry matters in the iron solution. The smell disappears slowly on storing the leather, but it is strongly objected to by boot manufacturers.

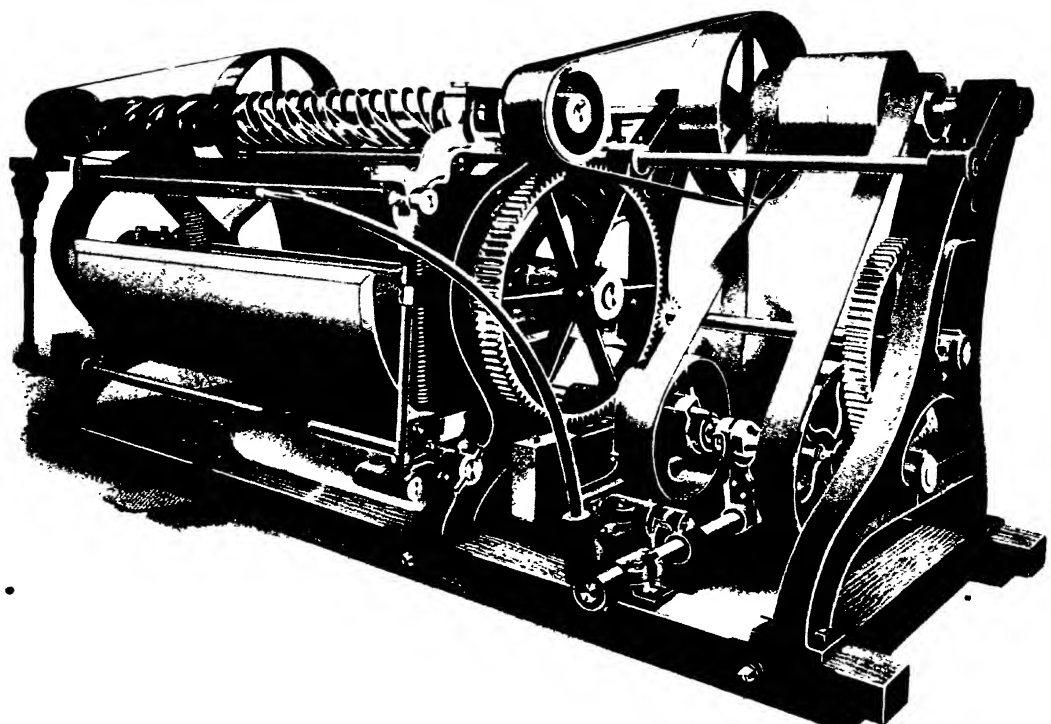


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Fig. 85.—Drum Setting-out Machine.

§449. Many leather dressers prepare their own solutions of iron, by dissolving scrap-iron in some weakly acid organic liquor such as sour cyder, beer, etc. Very good iron-solutions for blacking leather can be produced in this way, solutions which do no harm whatever to the leather if used weak. The common method of preparation is to place some scrap-iron in a wooden cask fitted with a vent tap, then to add the sour liquor and allow the mixture to stand for several days, in which time sufficient iron will have been dissolved to furnish a solution fit for use.

§450. Weak solutions of iron are also used as agents to sadden colour when staining or dyeing with the basic coal-tar dyestuffs. The iron salt in staining is sometimes applied to the leather before the dyestuff is applied, and sometimes in conjunction with it. When very small quantities of iron are used no injurious effect upon the leather is likely to be caused, as there is generally sufficient tannin matter present in the leather for the iron to combine with. The use of too much iron however for this purpose is not advisable (§401).

ALUMINIUM.

§451. Aluminium mordants are chiefly useful when dyeing yellows with fustic or turmeric (§418) and when dyeing reds with peachwood (§410).

§452. ALUMINIUM SULPHATE.—Cake alum, concentrated alum or patent alum, is the most important and economical of the aluminium mordants; the commercial salt containing from 48 to 50 per cent. of aluminium sulphate, whereas the ordinary alum of commerce contains only about 37 per cent. As the aluminium sulphate is the useful constituent of ordinary alum (§453), and as the price at which aluminium sulphate is sold compares favourably with that of commercial alum, it is economical to use the aluminium sulphate.

§453. ALUM.—The alum of commerce is either potash alum or ammonia alum and the properties of these for dyeing purposes

are the same. Both potash alum and ammonia alum contain less of the mordanting principle than does aluminium sulphate; the ammonium or potassium sulphate that they contain is useless.

§454. Aluminium sulphate is used for mordanting chamois and oil-dressed leathers, §998, and it is sometimes employed for re-tanning vegetable-tanned leather.

Titanium.

§455. Salts of titanium serve a double purpose; they may be used as fixing agents (§308) for use previous to dyeing with the basic colours (§301) and may oft times be used in conjunction with the acid colours (§330) with advantage, especially when fast shades of colour are required. Titanium salts, unite with the tannin matter of the leather to form a yellowish brown titanium tannate on the fibre of the leather; this titanium tannate being exceedingly fast to light and to the action of soap.

§456. The salts of titanium which have attained any degree of commercial importance are:—Potassium titanium oxalate, tanno titanium oxalate and titanium lactate ('Corichrom.').

§457. A solution of the titanium salts may be applied to tanned leather either with the brush or in the dye-bath, the colours produced being influenced by the strength of solution used, and by the nature of the tannage of the leather. The colours range from a bright yellowish brown, somewhat resembling the shade produced on leather by Phosphine, to a reddish yellow similar to that produced by Indian Yellow R. These of themselves are exceedingly good commercial shades and they may be modified, if so desired, by the employment of dilute solutions of chrome or iron or by afterwards dyeing or staining with the acid or basic colours; or acid dyestuffs may be mixed with the titanium solution (§462.)

§458. Titanium salts may, as above mentioned, be used for fixing (§308) and when shades of yellow, brown, green, red, maroon, etc., are to be eventually dyed, are more economical

for this purpose than tartar emetic; the yellow colour produced by the titanium materially assisting in the production of a full shade and thus economising the dyestuff. When bright shades of blue or violet, or pale shades are required, the yellow shade of the titanium tannate would be an objection and the fixing must then be done with tartar emetic (§473).

§459. A variety of shades can be produced with the natural dyestuffs (Chapter VI) using titanium as a mordant.

§460. Titanium is useful for the fixing of the tannin mordant, necessary when most colours are to be produced on chrome and combination chrome-leather (Chapter XXII).

§461. A solution of about 1 per cent. strength, (say 1 lb. in 10 galls. water) of the salts, produces a good commercial shade of yellow brown suitable for saddlery, strapping, harness, etc., when applied with the brush by staining. In admixture with a suitable acid dyestuff, e.g., Acid Anthracene Brown R. (By.), Fast Brown, etc., the shade can be modified to a browner shade of tan brown.

§462. Basic dyes are precipitated by the addition of titanium salts to a solution of the dyestuff but acid dyes may be mixed with a solution of titanium without precipitation taking place.

§463. In the dyeing of fast colours, principally browns on hat-leathers, titanium is being used in commercial quantity, the goods are treated with a solution of the salt in tray or paddle, afterwards dyed in a solution of a basic dyestuff and finally any loose titanium or dye being fixed by paddling in a solution of some tanning material such as oakwood or sumach extract after an intermediate washing.

CHROME.

§464. CHROME ALUM (potassium chromium sulphate) is obtained as a bye product in the manufacture of several coal-tar colours.

§465. Chrome alum is useful for mordanting chamois leathers, (Chapter XXV), and in the form of a basic solution of chromium sulphate (prepared by adding a calculated amount of an alkaline carbonate to a solution of normal chrome alum) it is largely employed for re-tanning vegetable-tanned leathers, Persians, kips, etc., producing a combination chrome-leather Chapter XXIII).

§466. Potassium or Sodium Bichromate is sometimes employed as a saddening agent when dyeing vegetable-tanned leather brown. Potassium bichromate, owing to the property it possesses of readily giving off oxygen in the presence of organic matter, acts not only as a mordant but as an oxidising agent, developing some colours and destroying others. It must therefore be used with great caution as a mordant for leather. Its use as a saddening agent when dyeing browns is not to be recommended. If, however, the bichromate is used, it is advisable to first prepare the leather with either sumach or cutch in order that there may be an excess of tannin in the leather for the salt to oxidise and that the tannin proper to the leather may not be oxidised and the leather injured. Even if the leather is prepared as stated, too much bichromate of potash still means too little tannin, and the leather produced is apt to be tender, or brittle and hard, owing to the deficiency of tannin matter. The colour, moreover, finishes badly, especially if it has to be glazed; the shade having a rusty hue with a very poor appearance.

§467. Potassium Chromate (Yellow or Neutral Potassium Chromate) is sometimes used as a saddening agent for which purpose it is better than the bichromate (§466) as there is little liability of injuring the leather; more of this salt is required to produce the same degree of saddening. The chief use of potassium chromate is as an addition to the dye-bath when penetration of the dye through the leather is required.

Lead.

§468. Lead Acetate.—Sugar of lead is prepared by dissolving lead oxide (litharge) in acetic acid. The brown sugar of lead

is prepared by dissolving the litharge in pyroligneous acid (crude acetic acid). The chief use of lead acetate is in lead "bleaching." (§187).

TIN.

§469. STANNOUS CHLORIDE, tin crystals or tin salt, is the only tin mordant of any importance. It is principally used in conjunction with cochineal when dyeing scarlets (§414).

§470. 'TIN SPIRITS' is the name usually applied to a solution of tin made by dissolving tin in a mixture of hydrochloric and nitric acids. The solutions of tin thus obtained are usually extremely acid and injurious to the leather. They also, like stannous chloride, were used for the production of scarlets with cochineal. Their principal use some years ago in leather dyeing and staining was for staining Russia red, a solution of the tin spirits being brushed on the leather followed by a decoction of one of the red natural colouring matters such as Brazil wood (§410). As before mentioned, these solutions are extremely acid and as the acid was never neutralised in the leather, the dyed material soon became brittle and tender. The use of these acid salts of tin is undoubtedly responsible for the disrepute that Russia leather has fallen into with the general public; experience has shown that Russia leather would not last for more than a year or so on a book binding without the binding breaking or the book falling to pieces. There is now, however, no reason why Russia leather should not last as long as any other kind of leather if the material is properly coloured with coal tar dyestuffs. Tin spirits are now seldom employed by leather dressers.

COPPER.

§471. COPPER SULPHATE.—Blue Vitriol, or blue-stone, is frequently employed in conjunction with iron in staining blacks with logwood and cutch. It can also be employed for saddening, in dyeing or staining. Blacks produced when the addition is made of a copper salt to the iron mordant, are faster to light than when the latter alone is used.

§472. Copper Acetate.—This salt is to be preferred to copper sulphate, and for the same reason that iron acetate is preferable to iron sulphate, because when the metal combines with the tannin or colouring matter with which it is to react, the acid liberated is volatile. Copper acetate is precipitated by all tanning materials, and it is therefore a much better mordant than copper sulphate, since it fixes the tannin.

Antimony.

§473. Tartar Emetic (Antimony Potassium Tartrate) is the principal antimony salt used for fixing previous to dyeing with basic colours (§308). It is usually sold in powder form and is soluble in water to the extent of 8 lbs. in 10 gallons. The commercial article is often adulterated with zinc sulphate, and other substances.

§474. Antimony Lactate is a patented product sold in the form of lumps; the product being not crystallisable. The advantages claimed over tartar emetic are its extreme solubility and its slightly lower price.

CHAPTER VIII.

COLOUR AND COLOUR MATCHING.

§475. As the preliminary to a comprehension of the art of matching colours, a general knowledge of the physics of colour is absolutely necessary, and it must be borne in mind to begin with that colour is a sensation, and has no actual material existence. As far back as the year 1665 Sir Isaac Newton discovered that when a beam of sunlight is passed through a triangular glass prism, the beam of light is dispersed into a number of coloured rays of light, which rays of coloured light, if permitted to fall on a white screen, exhibit themselves to the eye as a many-coloured riband; the colours running in parallel stripes and having no definite edges, but blending gradually into each other. This striped riband of colour is called a *spectrum*, and if instead of on a screen, it is received on a concave mirror, or on an ordinary focussing lens, the rays of coloured light will all recombine at the focus of the mirror or lens, and appear again as white light.

§476. When the solar spectrum, the spectrum of the beam of sunlight that is to say, is examined, it is seen to consist essentially of six stripes of colour, the colours taken in the order in which from top to bottom they appear on the screen, being those well-known as red, orange, yellow, green, blue, and violet. The Fig. 86 which follows, illustrates Newton's experiment.

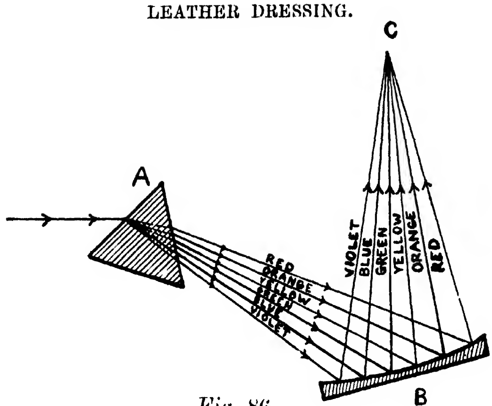


Fig. 86.

A is the triangular glass prism and the beam of light in passing through the prism is refracted and split up into the various coloured rays which form the spectrum. The spectrum falling upon the concave mirror B is reflected and the coloured rays re-combine to form white light, at C the focus of the mirror.

§477. Conspicuous amongst the stripes or bands in this spectrum or riband of colours are the red, the yellow and the blue; and these three colour-sensations the Brewsterian theory of colour regards as the *primary* colour-sensations. The theory is so called after Dr. Brewster, who was its principal exponent. At the present day, however, the Brewsterian theory is discredited, and nearly all authorities agree in selecting as the predominant or primary colour-sensations of the solar spectrum the three, red, green, and violet. And it is when these sensations are compounded together in different proportions or degrees, either two together or all three together, that other colour-sensations in infinite variety are produced.

§478. That red, green, and violet, are the three primary colour-sensations is the creed of latter days. It did not wait however for latter-day authorities to make the discovery; an ancient-day authority gave it to the world. The truth was realised and given to the world by Aristotle, the Greek philosopher, some 2,200 years ago or more, 300 years B.C., that is, in the words—"Scarlet, green, and violet are not produced by mixture, *and these are the colours of the rainbow.*"

§479. Re-united by concave mirror or by lens (§476), the rays into which a beam of light separates on passing through a prism, once more combine as white light. In our every-day lives, the eye takes the place of a lens, *is* a lens indeed and effects the re-union. Whatever number of coloured rays of light are received by the eye at one time, the resultant sensation is always the sensation of a single colour, in scientific language is *monochromatic*. If red and green rays of light are received by the eye at one and the same time, then, according to their relative proportions, the sensation to the eye will be of any colour of the spectrum from red, through orange and yellow, up to green. Similarly green and violet rays received together by the eye, would produce, according to their proportions, the sensation of any colour of the spectrum from green, through all the intermediate blues, up to violet. The effect of red, green, and violet rays of light being received together by the eye would be a monochromatic sensation, and if the three rays are of equal strength the resultant sensation would be white. These effects can be shown experimentally by coloured lights blended by means of a lens and focussed on to a screen.

§480. If a circular white card painted as represented in Fig. 87, that is in colours approximating to those of the spectrum, is mounted on an axis passing perpendicularly through its centre, and rapid rotatory motion given to it, the colours will blend together as it were and show as white. Or if a top is similarly painted from peg to dome, and the top is spun, there will be a like blending of colours when the top is 'asleep,' and it will appear white. In each case the ocular impressions of the different colours succeed one another in the eye with such rapidity that the eye, (the brain really), blends them.

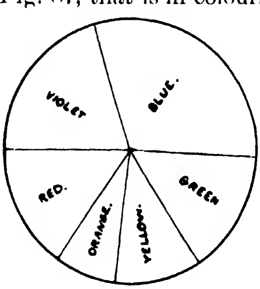


Fig. 87.

§481. In respect of external objects, colour is not an inherent physical quality in them, but arises from what may be called their

selective absorption of some of the rays of the light that falls on them and selective reflection or transmission of others of the rays, and it is the reflected rays that produce the colour sensations that the objects severally convey. It would be irksome in the extreme however to have to talk colloquially in the following stilted fashion :—'the rays of light reflected from this object give me the sensation of the colour red'; 'the rays of light reflected from that object give me the sensation of the colour green,' and so on,—and consequently in ordinary speech, the fact that colour *is* a sensation is not expressed but is assumed to be understood, and we speak of objects as though they actually possessed colour, and say—'this object *is* red'; 'that object *is* green,' and so on.

§482. That Chinese White is white because it is a property of the particles of which it is composed to reflect all the rays of the light falling upon it. An object is black because it absorbs all the light rays and reflects none. A field of grass is green because the object, grass, absorbs all the rays of the white light falling upon it except the green rays, which alone it reflects. Colour, that is to say, is due to the subtraction from white light of some of the rays which constitute it.

§483. Particularly must we bear this in mind when we are dealing with 'pigments.' We may define a pigment, broadly, as the colouring material which when mixed with oil, or water, or gum, forms a paint or dye. And we may look upon a dye as differing from a paint, in that it is applied in solution and is designed to sink into the substance to which it is applied and to be fixed in that substance by immersion. Nature abounds in colouring matters, and art has added to the number. We are in the habit of regarding pigments as monochromatic, but the colour of pigments is never even approximately monochromatic. All yellow pigments for example are found to transmit not only yellow rays but also red, orange, and green; and blues to reflect not only blue rays, but varying proportions of green, violet, and red. And this fact that pigments, the materials with which the leather dyer has

to work, with which he has to make his matches to patterns supplied to him, are not monochromatic, decides for the leather dyer what shall be his *theory of colour*.

§484. The scientific theory that the three primary colours are red, green, and violet, is for the scientific man. He has to deal with rays of coloured light, *pure* colours. The leather dyer however knows nothing of pure colour in the dyes he has to employ, they are all *impure*, and, however scientific he may be, he finds that, *in practice*, with his impure colours, his three primaries are, as they have been for painters and dyers from the earliest times, red, yellow, and blue. Mixing two pure spectrum rays of coloured light, the resultant colour is the sum of the two colours, and the admixture is a step towards white light. Mixing two dyes together however, both impure, the colour of one of which is what it is by the subtraction from the light that falls upon it of certain of that light's rays, and the colour of the other of which is what it is by the subtraction from the light that falls upon it of certain other of the light's rays, we take from white light *the sum of the two subtractions*; that is to say, the admixture of the two colours is a step away from light, a step towards darkness. And a mixture of dyes of all colours would be the absorption of all the rays of the light falling upon the mixture, and the production of black as a result.

§485. The experiment of a disc coloured approximately to the spectrum of white light and of a top similarly coloured has been referred to above. But the result is always disappointing. The colours on the disc and top are of necessity pigment colours, and the blending of these by rapid rotation produces a colour that can be called white by courtesy only, lacklustre and hueless.

§486. The three primary colours of practice, are what the dyer has to study, and dealing always with pigments, has to make the most of. All other colours than white differ from white simply in the relative strength of the components. When dyeing bright shades of colour a single dyestuff as near the desired shade as possible should be employed, for if the colour is got at by two

dyestuffs, it is likely to be much darker in shade than when one alone is used. Thus a green produced by mixing a blue and a yellow will be a much darker shade than a green produced by a green colouring matter. When dark shades of colour are required a mixture of colours is economical (§494).

§487. If one part of any whole is considered by itself, then all the other parts of the whole are *complementary* to the one part; they make up the whole, they supply what the one part lacks to make it a whole. And thus with colour. The three primaries in equal proportion make up the whole, white; and this is so whether we consider the scientific theory of light or the practical theory. Considering any one of the primaries by itself, it is evident that to make up the whole, white, the other two primaries are necessary. And the colour therefore that is produced by the other two when compounded is said to be complementary to that of the first primary. Thus the complementary colour to red in the Brewsterian or practical theory of colour, is green, the colour made up of yellow and blue; the complementary to yellow is violet, (red and blue), and the complementary to blue is orange, (yellow and red). And, speaking generally, any compound colour which when united with a third colour, will produce white is the complementary colour to that third.

§488. A convenient method of easily finding the complementary colour is by means of the Chromatic Circle, (Fig. 88). It will be noticed that the colour at one end of the diameters is complementary to that found at the other; thus green is complementary to red. The chromatic circle may be considerably amplified to include eight or more pairs of complementaries.

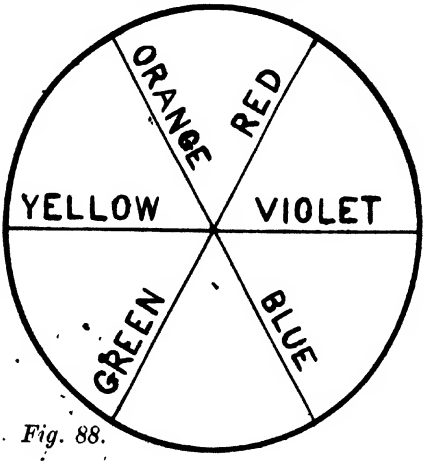


Fig. 88.

§489. The following table gives a list of colours complementary to each other (the complementary colours being bracketed together), and a list of acid dyestuffs which may be taken as corresponding.

§490. PAIRS OF COMPLEMENTARIES.

Red	Fast Red.
Bluish Green... ...	Fast Green Blue Shade, or Cyanole.
Orange	Orange II or Mandarine G.
Dark Blue	Bavarian Blue, or Lanacyl Blue.
Yellowish Orange ...	Orange G., Crocein Orange GG.
Reddish Blue... ...	Acid Violet 4B., 6B.
Greenish Yellow ...	Quinoline Yellow.
Violet	Acid Violet R.
Yellowish Green ...	Acid Green G.G.
Crimson...	Fast Scarlet B.
Green	Acid Green B.B.
Reddish Violet ...	Acid Violet 4R. or Bordeaux.

§491. The mixing of a complementary colour (see §487) with the colour to which it is complementary is a step towards darkness, when actual dyeing is being performed, as the one colour absorbs all the rays of its complementary. This property of complementary colours is often made use of in dyeing instead of employing an actual black dyestuff. Browns may be produced on leather by the addition of small quantities of blue, green, or violet to an orange, the whole mixture being then essentially a mixture of red, yellow, and black.

§492. Actual black added to reddish oranges gives brown; in the same manner a yellowish red and a pure yellow will give a bright scarlet, but bluish red and greenish yellow will only produce a dull shade of red. Another practical example that may be cited:—A bluish green in mixture with a greenish yellow will produce a bright green, whereas a reddish blue in mixture with a reddish yellow produce a sage green, since the red and green pro-

duce black. Black added to yellowish green gives an olive, and to a bluish green, sage green; to purples and bluish reds, maroons and clarets; and to bluish violets, slates.

§493. It is impossible in this work to deal fully with the subject of colour and colour mixing. The reader is referred to the text books on the subject; amongst them may be mentioned:—*Colour*, A. H. Church, (Cassell & Co.); *Colour*, G. H. Hurst, (Scott Greenwood & Co.); *The Science of Colour Mixing*, David Paterson, (Scott Greenwood & Co.); *Colour Vision*, Sir W. de W. Abney (Tyndall lectures).

§494. It is obvious from what has been said, that if the dyer has a thorough knowledge of colour and colouring matters he may effect a considerable economy in his dyestuff. A brown may be dyed upon leather by using a scarlet or an orange dyestuff and toning down the shade by the addition of blue and green, that is, by the addition of the third practical primary, blue. An amount of black is thus introduced and a brown shade results; and the greater the amount of black introduced the browner or greener will be the resulting shade.

§495. The following patterns illustrate the above remarks:—

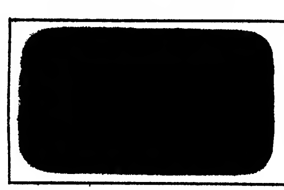
Dyed with
(1.) 4 ozs. Cardinal Red J., (R.H.& S.)
5 ozs. Indian Yellow R., (By.)
$1\frac{1}{4}$ ozs. Cyanole Extra, (C.)

Per 3 doz. Skivers.

Dyed with [MOO., (C.)
(2.) 2 ozs. Brilliant Crocein
8 ozs. Indian Yellow R, (By.)
$\frac{3}{10}$ oz. Fast Green Blue Shade, (By.)

Per 3 doz. Skivers.

(1.) 

(2.) 

§496. The addition of black to green produces shades of sage green or olive green. Heavy shades of green can be produced by

the addition of orange or red to green (§497). By this addition a heavy shade of green is obtained such as would perhaps not be equalled by using twice the amount of dyestuff, if the dyeing mixture were, say, of green, yellow, and an addition of a black dyestuff, which is a mixture quite commonly adopted for producing such shades.

§497. The patterns that follow show conclusively the effect of adding gradually increasing quantities of red to a green, in order to introduce a certain proportion of black into the dye-bath, that is, by the addition of the third practical primary red, to green which latter may be regarded as a mixture of blue and yellow.

Dyed with

(3.)

4 ozs. Quinoline Yellow, (By.)
6 ozs. Acid Green, (W. t. M.)
per 3 doz. Skivers.

(4.)

4 ozs. Indian Yellow R., (C.)
6 ozs. Acid Green, (W. t. M.)
per 3 doz. Skivers.

(5.)

4 ozs. Atlas Orange RS., (Ce.)
6 ozs. Acid Green, (W. t. M.)
per 3 doz. Skivers.

§498. Quinoline Yellow, it is necessary to state, dyes a pale sulphur shade of yellow, Indian Yellow a reddish yellow, and Atlas Orange a reddish orange. For each of the above patterns the same amounts of dyestuff were employed; the difference in depth of shade between pattern and pattern is very noticeable.

§499. The following pattern shows a myrtle green, produced by a mixture of orange and green in different proportions to those given above.

(6.)

Dyed with

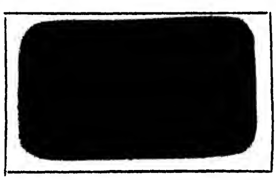
2½ ozs. Orange II, (B.)

5 ozs. Acid Green B.B. Extra, (By.)

per 3 doz. Skivers.

§500. The patterns annexed here show the results respectively of dyeing a mixture of a pure yellow and reddish blue and a reddish yellow, and a reddish blue.

(7.)



Dyed with

8 ozs. Quinoline Yellow, (By.)

2 ozs. Blue III, (L.)

per 3 doz. Skivers.

(8.)

8 ozs. Indian Yellow R., (C.)

2⅔ ozs. Water Blue 3 B, (Ber.)

per 3 doz. Skivers.

§501. Reddish blues added to orange produce shades, on the one hand of chocolate brown, and on the other olive green. The attached pattern shows a heavy shade of chocolate brown produced in this way.

(9.)

Dyed with

8 ozs. Atlas Orange RS., (Ce.)

2 ozs. Blue III. (L.)

per 3 doz. Skivers.

§502. Much economy can therefore be effected in the dyeing of leather by bearing in mind and taking advantage of the fact, that complementary colours when mixed produce a proportion of black, and by using those colours for this purpose that are cheap; for example, oranges, scarlets, reds, and greens, which in most cases are cheaper than violets, blues, browns, etc.

§503. The patterns here attached are further examples of the mixing together of complementary colours.

(10.)

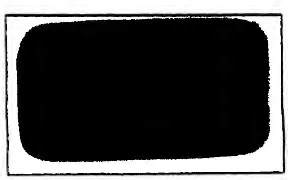
Dyed with

2 ozs. Guinea Green B., (Ber.)

6 ozs. Fast Red AV., (B.)

per 3 doz. Skivers.

(11.)



5 ozs. Acid Green, (R.H. & S.)

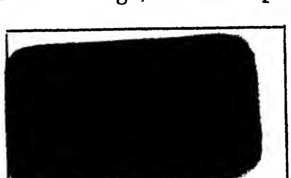
2½ ozs. Fast Red S., (M.L. & B.)

per 3 doz. Skivers.

§504. Compound shades can be dyed either by actually mixing the colours together in one solution as above, or can be produced by bottoming with one colour, and afterwards topping with another. Thus leathers dyed a weak shade of green or blue and afterwards topped with an orange, produce dull shades of greenish or sand brown.

§505. The annexed patterns show the production of a greenish brown by this method. If less of the Erioglaucine is used and more of the orange, the shade produced is browner.

(12.)



Dyed with

2½ ozs. Erioglaucine, (G.)

per 4 doz. Skivers.

(13.) 

Dyed first with $2\frac{1}{2}$ ozs. Erioglaucine, (G.), and topped in dye-bath with 4 ozs. Cuba Yellow, (W. Bros.), and 5 ozs. Orange II, (C.)

per 4 doz. Skivers.

§506. The various shades resulting from the mixture of complementary colours are given in the following table:—

COLOURS MIXED.		
Colour in Excess.	*Colour not in Excess.*	*Resulting Shade.*
Bright Red.	Yellowish Green.	Bluish Maroon.
Yellowish Green.	Bright Red.	Sage or Olive Green.
Reddish Blue.	Yellow.	Purple or Bluish Plum.
Yellow.	Reddish Blue.	Olive Green.
Reddish Yellow.	Bluish Red.	Dull Claret.
Bluish Red.	Reddish Yellow.	Maroon.
Bright Red.	Blue.	Dull Reddish Violet.
Blue.	Bright Red.	Bluish Violet.
Blue.	Orange.	Slate Blue.
Orange.	Blue.	Sand or Russet Brown.
Bluish Green.	Dull Red.	Myrtle Green.
Dull Red.	Bluish Green.	Brownish Red.
Bluish Maroon.	Yellowish Green.	Bluish Violet.
Yellowish Green.	Bluish Maroon.	Blue Black.
Orange.	Bluish Maroon.	Claret Red.
Bluish Maroon.	Orange.	Dull Reddish Maroon.

§507. The variety of shades that can be produced from a very few of the fundamental colours is enormous, and it is a lack of knowledge on the part of the leather dyer of the principles of colour mixing, that is responsible in many instances for the large number of dyestuffs which he stocks for the production of his shades. For the production of most of the commercial shades

upon leather, only a few carefully selected colours are in truth required, either when staining or when dyeing; by judicious and careful mixing shades can be varied at will, and by varying the proportions of the mixture of not more than three dyestuffs, it is possible to produce as many as one hundred or more colour shades.

§508. It may not be out of place to here give a short list of the coal-tar dyestuffs which it is necessary to keep in stock for the production of almost every commercial shade when dyeing or staining, with acid colours.

Colours.		*Dyestuffs.*
Bright Yellow	...	Quinoline Yellow or Napthol Yellow.
Reddish Yellow	...	Indian Yellow or Azo Flavine.
Orange ...	...	Orange II, Mandarine, Atlas Orange.
Red ...	...	Fast Red.
Maroon ..	...	Bordeaux or Acid Magenta.
Blue ...	...	Water Blue.
Green ...	...	Acid Green.
Violet ...	...	Acid Violet.
Brown (light)	...	Fast Brown, Resorcine Brown.
,, (heavy)	...	Acid Anthracene Brown R.
Black ...	...	Napthylamine or Acid Black.

Any maker of coal-tar colours would supply a full set of 11 colours similar to those mentioned and to be used as mentioned, and which would mix well with each other.

§509. Dyeing to Pattern.—The value of a leather dyer depends mainly upon his ability to dye to pattern. It is easy to dye a variety of shades upon leather; but to dye, say five dozen skins, to a shade accurately matching a small pattern supplied, is a very different thing indeed, and this art, for an art it really is, severely tests the ability of the leather dyer.

§510. Having discussed the principles of dyeing-mixtures, we will now discuss the practical methods of dyeing to shade. On receiving a pattern which it is desired to match on a pack of goods,

the first thing the dyer has to do is to consult his pattern book in order to ascertain what mixture of colours has previously produced a shade as near as possible to the pattern; having obtained this information and also noticed whether the shade in his pattern book is lighter or darker, redder or yellower, than the pattern to be produced, and any other characteristic differences between the former and the latter, he proceeds to make a stock solution of each of the colours applied to produce the pattern in his book. For purpose of example we will discuss the dyeing to a shade of brown; this has probably been obtained for his book sample by the mixture of a reddish brown, a yellow, and a green, and the dyer makes, therefore, a stock solution of each of these colours by separately dissolving for each, say, 1 lb. of dyestuff in 3 gallons of boiling water. The dye-bath is now got ready and the dye solution added in a proportion that will produce a somewhat lighter shade than is required. The goods are entered into the dye-bath and the dyeing proceeded with. In the meantime the pattern which it is desired to match (or a portion of it) has been wetted down, so as to be able to compare this wet pattern with the goods in the process of dyeing. When the pattern is a glazed one, the dyer will match the goods as near as possible to the dry glazed pattern, this being a better guide to an exact match than the wet pattern, the appearance of the goods when wet in the dye-bath being a good criterion as to the shade they will become when dried out, and glazed under pressure. During the dyeing the goods are carefully watched, and when they begin to attain a full colour they are repeatedly compared with the pattern, and more solution is added according as to whether the shade is as dull, as yellow, or as red as the pattern to be imitated; the green, yellow, or brown, being added in small quantities. A plan to be followed where possible, as the dyeing proceeds, is to cut a small piece off one of the skins and rapidly dry it out, say on the boiler if this is conveniently handy, and compare it with the pattern. A better plan and one adopted by many dyers is to have one whole skin rapidly dried to make comparison with, before completing the drying of the pack. If the pattern supplied has been finished with a mucilage, (linseed, etc.), or some other

material, allowance must, of course, be made for the difference in colour that will come about in the subsequent finishing.

§511. The examination of colours under artificial illuminants has now to be considered. This is a matter of very great importance to the dyer, for such examination reveals many little peculiarities as to colour which would otherwise escape his detection. Two shades of brown may accurately match each other in daylight, and yet exhibit a marked difference when viewed in gas-light. The same may be said of greens, of blues, and of many other colours, especially those of a compound nature. Two good examples of this difference in colour are shown on page 177, Patterns 7 and 8. Pattern 7, which is a shade of green in daylight, changes to a slate when examined in gas-light, and Pattern 8 changes from a shade of olive green in daylight to a drab when viewed in gas-light. This change can be readily noticed by examining the patterns, when shaded from direct daylight, by means of a lighted match. Paterson in his book *Matching of Shades on Textiles*, tells an amusing tale of a dyer who had to match an imitation tiger skin. He dyed the reddish-brown ground of the skin with a mixture of an orange and a green. The match was perfect when viewed in daylight, but judge of his discomfiture when, on examination by gas-light, he found that he had the tiger's black stripes on a *green* skin!

§512. All the natural colouring matters when applied to leather or other material incline more or less to look redder when viewed by gas-light; the coal-tar colours behave very differently. Violets lose in their blueness and gain in their redness, blues become greener, purples become reds, greens take on yellowness, oranges become yellower and brighter, and scarlets become bright oranges. Very deep shades of blue and green appear black, and pale shades of yellow almost white, by gas-light. Shades of colour produced by mixing dyes, such as greys, olives, drabs, russets, slates, &c., are particularly sensitive to change of illuminant, and vary in appearance according to the dyes used in the production of the shades. It is outside the scope of this book to

enter deeply into the reasons for the changes in the appearance of colours according to the light they are viewed in. All that need be said here is that artificial light is deficient in blue and violet rays, and colours viewed in such light consequently appear richer in yellow and red than they actually are.

Colour-Matching by Artificial Light.

§513. Especially in large towns, where the atmosphere is dense, considerable difficulty is experienced by the dyer and stainer in obtaining accurate matchings. Also in the winter months, when the period of daylight available for colour-matching does not exceed two or three hours at the outside, and when, often for days together, there is really no good daylight. When two pieces of leather are dyed or stained an accurate match by daylight, the same dyestuffs being used for each, they will remain a match when viewed in any artificial light, though the colour of the two pieces may vary considerably from the colour they show when examined by daylight. If, however, as happens in practice, a daylight match is made of a colour, also produced in daylight, but in respect of which the dyer or stainer has no knowledge whatever of the dyestuffs used, it often happens that the pattern and its match do not by any means pair when seen in artificial light. And similarly when a pattern that has been produced in artificial light is matched in artificial light, and the dyer or stainer does not know the dyestuffs concerned in the production of the original, it will often be found that his copy is no match when the colours are viewed in daylight.

§514. Many of the up-to-date illuminants have been recommended for use in colour-matching, as for example, the electric-arc light, the acetylene light, the pressure-incandescent gas light, etc.; and certainly either of these is infinitely preferable to ordinary gas light or to the electric incandescent light. Neither of the three however shows colour in its true daylight aspect. And if a pattern is copied in an artificial light by a dyer ignorant of the dyestuffs used for the pattern, it is very unlikely that the colours will be found to match in daylight.

§515. The electric-arc light and the magnesium light are the two illuminants most commonly used when matching shades in dull weather or at night time. The light from the Dufton-Gardner electric-arc light is perhaps the best artificial illuminant as yet discovered for these purposes, for it is possible with this light to make a match which will accurately correspond to a pattern when the two are seen together in good daylight. This light is the ordinary electric-arc light surrounded by a globe of blue glass, and with the globe of exactly the right tint of blue glass. This light is being largely used by textile dyers.

§516. The magnesium light is a useful light. By burning a small strip, 5 or 6 inches say, of magnesium ribbon, the dyer gets a light which gives him a good idea of what the colour of his dyed leather will be by daylight. The magnesium ribbon lights easily, and is held in a small pair of pliers. Many colours, for instance, violets, blues, browns, sage greens, and olive greens, are particularly sensitive to change of illuminant and, as it were, change with the illuminant. Reds, oranges, yellowish browns, bright yellowish greens and full shades of reddish yellow, do not change materially, and can consequently be matched in almost any light. When shades various are to be dyed or stained, it is advisable to take the colours most sensitive to change by daylight, during the brightest part of the day, and to leave the reds and yellows and bright greens for the close of the day, when artificial light is imperative.

CHAPTER IX.

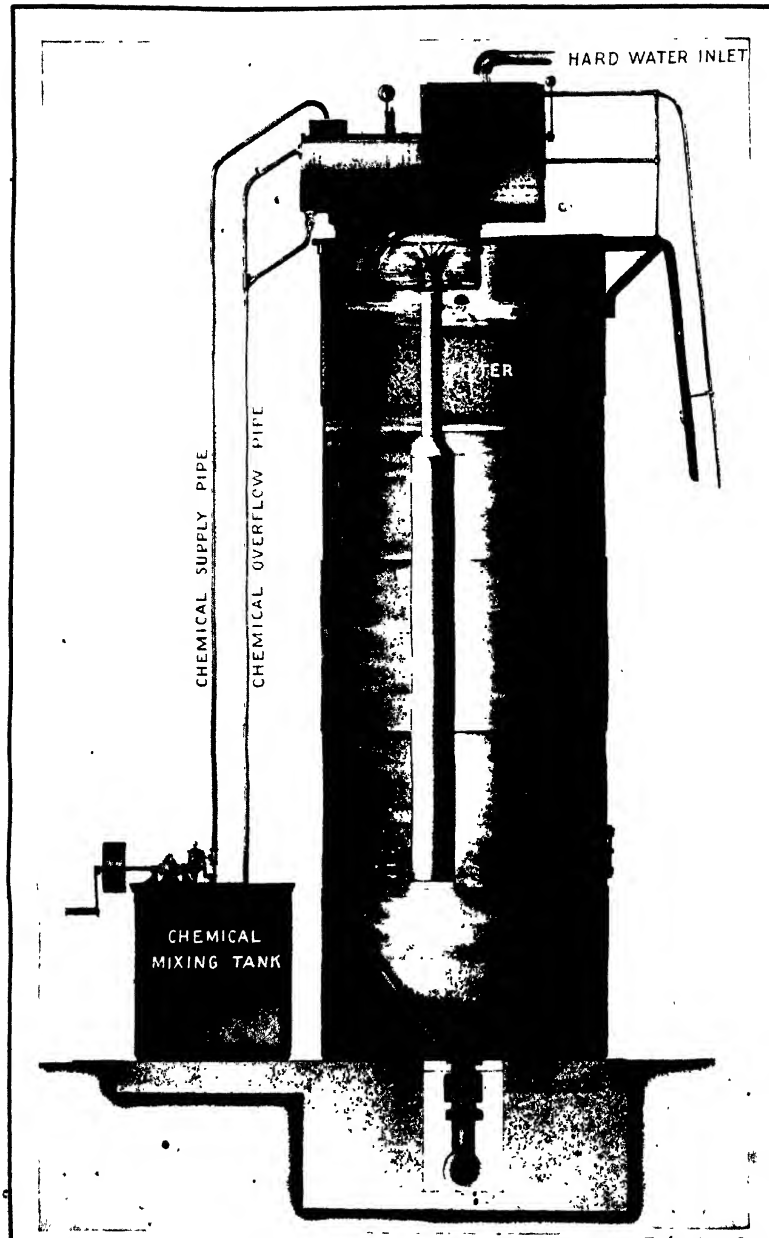
WATER.

§517. A supply of good soft water for use in dyeing and staining is a very practical necessity. By evaporation from the ocean, and condensation afterwards in the form of rain, mankind has the supply. The rain water either sinks into the earth to re-appear as springs and rivulets, or as the source of a river; or is recovered from the earth by the sinking of wells; or sets up surface waters, which help to the formation of rivers.

§518. Being the universal solvent, water, both during its passage through the air in the form of rain as well as in its travels over and under the surface of the land, dissolves various of the matters with which it meets.

§519. RAIN WATER.—Collected under suitable conditions, rain water is water in its purest condition and its softest, and contains only a trace of solid matter. Invariably it contains traces of carbonic, nitric, and nitrous acids, ammonia, oxygen, and nitrogen, gathered up in its passage through the air, and in towns it is specially impure, because of the comparatively large quantities of sulphuric and sulphurous acids it absorbs from the air, these acids being present as products of the combustion of the sulphur contained in coal and coal gas.

§520. SURFACE WATER.—The surface waters as they flow over the land take up more or less of the soluble matters they meet with in their course, and hold them in solution, and contain therefore a proportion, greater or less of soluble salts.



To face page 183.

Fig. 89.—Water Softening Plant.

§521. SHALLOW-WELL WATER.—This is water which has percolated through a few yards of permeable strata, until, meeting a less pervious stratum, such as clay say, it continues its course along the clay underground. If the water is obtained from a well sunk into this course, it is known as shallow-well water, or subsoil water.

§522. DEEP-WELL WATER.—Deep or artesian wells, (called 'artesian' because they are believed to have been first bored in *Artois*, in France), are very important sources of water supply, as they furnish practically an unlimited quantity. In the majority of cases however the water of these wells is extremely hard.

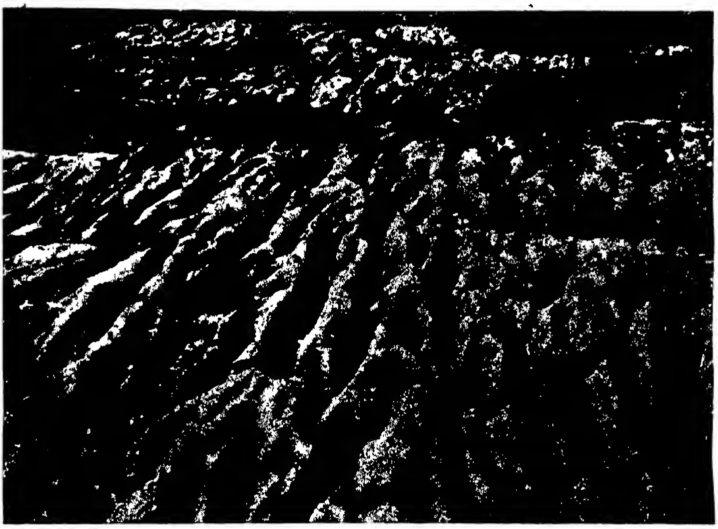


Fig. 90.

THE HARDNESS OF WATER.

§523. The hardness of water is due to the presence in it of mineral salts such as those of calcium and magnesium. A water is said to be hard if it requires much soap to make a lather with it, and said to be soft if it makes a lather with but little soap. There are two kinds of hardness in water, temporary hardness, and permanent hardness.

§524. Temporary Hardness.—When water holds bi-carbonates of lime and magnesia in solution it is 'temporarily' hard. Containing a small quantity of carbonic acid, as stated above, rain water dissolves limestone; doing this it has calcium bi-carbonate in solution, and this gives it the hardness now being explained. Fig. 90 shows a photograph of limestone rock which has been deeply furrowed by the dissolving action of rain water charged with carbonic acid. The hardness is called 'temporary' because it can be got rid of and the water be softened by boiling, the carbonic acid being driven off from the bi-carbonates on boiling and the lime and magnesia being deposited as insoluble salts. The like softening can be produced by adding lime or caustic soda to the water, the carbonic acid in the water uniting with the lime or soda. In the case of the addition of lime, calcium carbonate is precipitated, together with the calcium and magnesium carbonate previously present in the water as soluble bi-carbonates; in the case of the addition of caustic soda, the calcium and magnesium are precipitated as carbonates, and sodium carbonate remains in solution.

§525. Permanent Hardness.—A water that contains as impurities the sulphates of magnesium and calcium is called 'permanently' hard, as it is not softened by boiling. Some waters contain also chlorides.

§526. Temporary Hardness and Permanent Hardness, Relatively.—It is the temporary hard water that gives the most trouble when used for dyeing. If the water contains lime and magnesium bi-carbonates in considerable quantity,—'contains a large amount of temporary hardness,' in colloquial phraseology,—it acts upon the dyestuff. Specially is this so in the case of the basic colours. The dye is thrown down in the form of a curdy precipitate, and in part rendered useless; the precipitated dye moreover is deposited upon the leather, causing uneven shades, and probably also occasioning spots or streaks (§305); Victoria Blue, Victoria Black, Methyl Violet, and many other of the basic colours may be almost entirely precipitated if the temporary hardness is excessive in amount.

If the use of a temporary hard water is unavoidable, a little acetic acid should be added to the water (§369).

§527. The bi-carbonates of lime and magnesium are decomposed by the addition of an acid. Hence, in dyeing with the acid colours no precipitation of the dyestuff takes place, as sufficient acid is present in the dye-bath to decompose the colour-lake formed. When dyeing with the basic colours the bi-carbonates may be neutralised by the addition of a little acetic or formic acid, (§530), to the dye-bath.

§528. Each degree of hardness represents a soap-destroying power equivalent to $1\frac{1}{2}$ lbs. for every 1000 gallons of water. It will be at once therefore apparent to the reader, that when it is necessary for soap to be dissolved in the water, a great loss must take place if the water is at all hard. As an instance of this, it may be stated that in the Bermondsey district of London, the water contains 30 degrees of hardness; so that of the soap dissolved in 1000 gallons of the water, no less than just upon 45 lbs. is rendered useless, which is a very serious item in cost of manufacture. It is consequently always advisable, when using soap either for fat-liquoring or scouring, to employ if possible a soft water. The condensed water from the boiler is usually very suitable.

§529. The loss of soap is not the only disadvantage ensuing from the use of a hard water for making solutions. The sticky insoluble precipitate formed of calcium and magnesium soap, is very liable to be deposited irregularly on the goods. This will undoubtedly cause trouble later on, especially if the goods are to be dyed; moreover, if more than a trace of iron is present in the water, an insoluble iron soap will be precipitated on the leather, causing unsightly stains.

§530. All that it is usually necessary to do in respect of a water employed for general dyeing and staining purposes, is to carefully neutralise with an acid any temporary hardness present in the water. It may be done with either acetic or sulphuric acid. Sulphuric acid is much the cheaper, but care must be taken,

not to use it in too great quantity; used otherwise bad results may be obtained. When dyeing with the basic dyes, it is better to use acetic acid for correcting hardness, as a slight excess of the acid does no harm. More than a slight excess is harmful, for acetic acid has the effect of retarding the dyeing power of the basic colours; a large excess will indeed in many cases prevent the dye working on the leather.

§531. Permanent hard water does not usually give any great amount of trouble when employed for dyeing, except when the sulphates are present in large quantity. When so present considerable dulling may be occasioned in the dyed leathers. Especially is this the case with scarlets and pale bright shades. The hardness of a permanent hard water is just as destructive to soap as is the hardness of a temporary hard water, (§528).

§532. Iron Impurities.—These are highly objectionable, but fortunately are not often met with. The water in the Northampton district does contain them. When present in water, the iron is generally in the form of bi-carbonate. A water charged with iron impurity causes considerable dulling of the shades of colour when dyeing or staining, especially when the basic dyes are employed; it also dulls the colour of the leather in the preliminary sumaching. Such a water is particularly objectionable for use in fat-liquoring with a soap and oil fat-liquor; the bi-carbonate of iron acting like to, and even worse than, the calcium and magnesium bi-carbonates, for the precipitated iron causes black stains. If a water containing iron impurity is exposed to the air, say by storage in a large cistern, much of the iron bi-carbonate is precipitated.

§533. Alkaline Carbonates are sometimes present in water; it is usually sodium carbonate that is present. Water containing an alkaline carbonate should be carefully neutralised before using, with acetic, formic, or sulphuric acid.

§534. SULPHURETTED HYDROGEN is sometimes met with in water, usually in river and surface water. Water so charged is particularly detrimental if used in lead bleaching (§187); it brings about a considerable darkening of colour, (lead sulphide, a black salt, being generated), and retards the production of a white bleach.

§535. The hardness of water is often expressed in 'degrees' (§528), English degrees usually refer to grains of calcium carbonate (or equivalent in other salt) per gallon, i.e., parts per 70,000. It is now the custom to avoid the use of the term degree and to substitute 'parts per 100,000.'

CORRECTION OF WATER USED IN DYEING.

§536. Already this has to a certain extent been dealt with. Water may be corrected and made available for most dyeing purposes by the addition of the requisite quantity of a suitable acid, (§527.) The addition does not soften the water but simply converts the temporary hardness into permanent hardness.

§537. The amount of sulphuric acid (vitriol), required to neutralise the bi-carbonates present in 1000 gallons of water that needs correction may be easily estimated in the following manner. In a clean white basin place 1 litre of the water, accurately measured; add to this 25 drops of a 1% solution of the dyestuff, methyl orange, (this solution should be made with distilled water; or if preferred the solution may be purchased at a trivial cost from any manufacturing chemist). Now prepare a solution of the sulphuric acid that is to be used in correcting the bicarbonate-charged water, by diluting 6¼ grammes of the acid with 1 litre of distilled water, and from a graduated burette, a few drops at a time, add the sulphuric-acid solution to the water tinted with methyl orange solution. As the acid is added, stir carefully and continuously with a glass rod, until the colour of the mixed solutions changes from yellowish orange to pink, and then note the quantity of acid solution that has been added. The number of cubic centimetres that this represents will be the number of

ounces of the concentrated sulphuric acid that must be added to 1000 gallons of water.

§538. Water Softening.—There are a large number of water-softening appliances on the market, which are both moderate in price and efficient, and where the water supply is hard, an installation for the purpose of softening it by such a plant is worth consideration. When only hard water is available for the feeding of the boiler, a mechanical water-softener should certainly be set up, to help in the prevention of boiler-scale.

§539. The re-agent usually employed in water softening is a mixture of lime and soda-ash (sodium carbonate), or caustic soda. The addition of lime to a temporary-hard water brings about a combination between the half-combined carbonic acid of the bi-carbonate hardness and the lime, with the consequent formation of insoluble calcium carbonate, which is precipitated. The calcium and magnesium sulphates of permanent-hard water are converted into insoluble calcium and magnesium carbonate by sodium carbonate. It is of extreme importance as to either water that the quantity of the chemical used in the precipitation should be calculated to a nicety.

§540. The removal of temporary hardness by lime has already been spoken of (§524), and for dyeing purposes this re-agent is all that is necessary. The softening of the permanent hardness is effected by means of caustic soda or sodium carbonate; the calcium and magnesium sulphates being converted into insoluble carbonates. The re-action results, however, in the formation of sodium sulphate in the softened water, which in amount is slightly greater than the amount of calcium sulphate present as permanent hardness; and as sodium sulphate possesses the power of stripping many colours, its influence upon dyed leather is injurious when the latter is washed up, after dyeing, in such a water. For general dyeing purposes, as before mentioned (§531), the removal of the permanent hardness has no advantage.

§541. When softening temporary hardness by the use of lime, it will be understood that an excess of the re-agent will result in the excess of lime remaining in the treated water, causing it to be alkaline and more or less hard; the temporary hardness being first completely removed—and then the lime excess setting up a hardness of its own, (§539). On the other hand the use of an insufficient amount of lime will result in the incomplete removal of the hardness.

§542. The softening of water by the addition of a measured quantity of 'lime water' was introduced about 1790, and the method was to simply add a pre-determined amount of solution of lime to a measured quantity of water placed in a large cistern, thoroughly mixing, and then allowing to stand until the resultant precipitate of calcium carbonate had completely settled out, leaving the water quite clear. The process is commonly known as Clark's process. Owing to the large space required for the cistern or tank necessary, and the time requisite for the settling when any very large volume of water has to be dealt with, the method is inconvenient.

§543. Many of the water-softening appliances on the market are designed to deal with large volumes of water, and the plant occupies but little space. The first apparatus designed to mechanically mix the water with the lime re-agent, and to remove the precipitated calcium carbonate by filtration, was the 'Porter-Clark' water softener. In this apparatus the calcium carbonate precipitate is removed by filtration through a filter press. Space forbids the entering into a description at present of the mechanical construction of the many water-softening plants on the market, there being upwards of 20 such appliances manufactured by makers known to the author.

§544. In choosing a water-softening plant it is essential to make a point of its fulfilling the following conditions:—

1. It must occupy little space.

2. It should require little attention; the plant should be practically automatic.

3. That the re-agents necessary can be accurately adjusted to the water supply, and that the mixing of the re-agent and the water must be thoroughly done by the machine.

4. That the filtration must be effectual, and that the filtering apparatus, or filtering medium, can be easily cleansed or repaired.

5. Any variation of speed or irregularity in the water supply must be arranged for, and the decrease or increase necessary of the amounts of re-agent must be automatically adjusted by the machine.

§545. In respect of water that needs softening, an analysis of it should first be made, and a calculation from the analysis of the amount of re-agent or re-agents required for softening it. Actual trial with these theoretical amounts will show if the result obtained is satisfactory, and if not, will indicate in what direction and in what proportions variation of the amounts is necessary in order to secure the required reduction of hardness. The adjustment of the proportions of re-agents should be carefully made, whether the quantity of water that is being dealt with is small or large.

§546. The softening of water by means of lime and soda does not in the majority of cases affect the quantity of salts in solution in the water, but simply converts these salts into others of a less objectionable nature.

§547. Although lime and caustic soda or lime and sodium carbonate are the re-agents generally employed in water-softening, compounds of barium have been prepared for the purpose and give excellent results. One of these compounds is barium hydrate. The addition of barium hydrate to a water containing calcium and magnesium bi-carbonates and sulphates results in the complete precipitation of these salts; the barium carbonate, barium sulphate, and calcium carbonate formed being all insoluble salts.

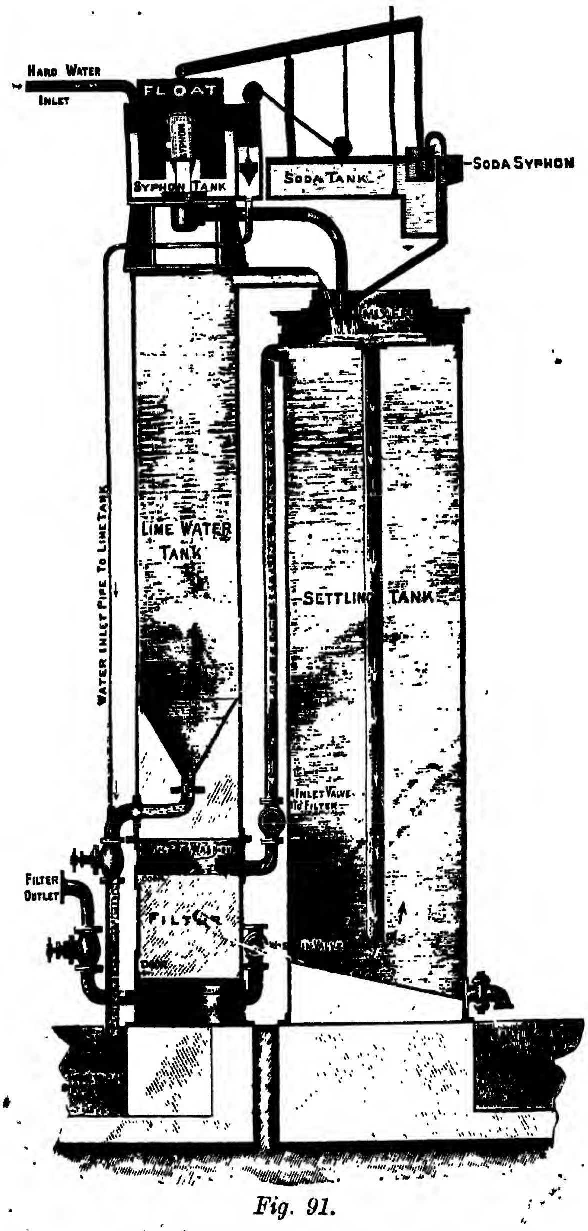
§548. Another such compound that is being used both in England and on the Continent is barium aluminate. This is an excellent re-agent for water-softening, as in addition to effectually removing the hardness of the water, it also, owing to the precipitation of alumina hydrate by the re-action, removes any organic matter that is present, the gelatinous precipitate carrying down the organic impurity.

§549. A word of caution is necessary in regard to barium salts, as they are extremely poisonous, and if the water to be softened is to be used for drinking as well as other purposes, the amount of the barium compound employed must be very carefully measured, (§545), and adjusted to the hardness of the water.

§550. For boiler-feeding, water containing any appreciable amount of hardness is objectionable; an excess of alkalinity also conduces to 'priming,' which is helped if vegetable or fish oil is used for lubrication; the liability of small quantities of the oil getting into the boiler with the feed water, being always present. A mineral oil is to be preferred.

§551. The action of the various water-softeners may be thus described in general terms. The water to be softened flows first of all into a vessel of known capacity. On emptying from this it receives measured quantities of the required re-agents, and the mixture of water and chemicals then runs into a settling tank. The heaviest of the suspended matters settle down at the bottom of this tank, the softened water passing from the tank through a filter, which clears it of all remaining precipitate, into a storage chamber or tank, from the outlet of which it emerges soft and bright.

§552. The 'Criton' Water Softener.—The Fig. 91 shows this softener in section. It is manufactured by the Pulsometer Engineering Company, Ltd.



HARD WATER
INLET
FLOAT
SYPHON TANK
SODA TANK
SODA SYPHON
LIME WATER
TANK
WATER INLET PIPE TO LIME TANK
SETTLING TANK
INLET VALVE
TO FILTER
FILTER OUTLET
FILTER

Fig. 91.

§553. From the hardwater inlet, (see Fig. 91), the water enters the syphon tank. This tank is divided by a partition into two compartments, one of which is emptied by means of a syphon and the other by means of a valve; the top of the partition is below the level at which the syphon begins to act. It is into the syphon division of the tank that the water is received, and as it rises, it runs over the partition and fills the valve division. Still rising in the tank, the water reaches the level at which the syphon acts, and the syphon compartment then automatically empties itself into the mixer, (see Fig. 91). In the syphon compartment is a float, which descends as the compartment empties. As it descends it lifts, by the agency of a lever working on a fixed axis, the valve of the valve compartment, and the contents of this compartment flow through the Water Inlet Pipe into the lime-water tank, which then overflows at top, and discharges, also into the mixer, an equal volume of water to that which it has received. The soda tank contains a solution of soda of given strength. To the end of the lever worked by the float is attached a bucket, which descends into the soda solution as the float rises and lifts out as it falls. When the bucket has risen clear of the solution, its contents come into contact with the soda-syphon, and are run out by a pipe into, again, the mixer.

§554. There is thus discharging into the mixer, and in the main simultaneously, a known quantity of the water to be softened, and measured quantities of lime-water and soda solutions; these quantities are exactly dependent on the quantity of water to be softened. From the mixer, through the central pipe, the softened water enters the settling tank at bottom, causing an overflow at top, which is conveyed through the Pipe-from-settling-tank into the filter. The course taken by the water from inlet to final outlet can be followed in the Fig. by the aid of the various arrows.

§555. The Bruun-Lowener Water Softener is made both in cylindrical form and square form. Fig. 92 shows side and end sectional drawings of the square type of apparatus.

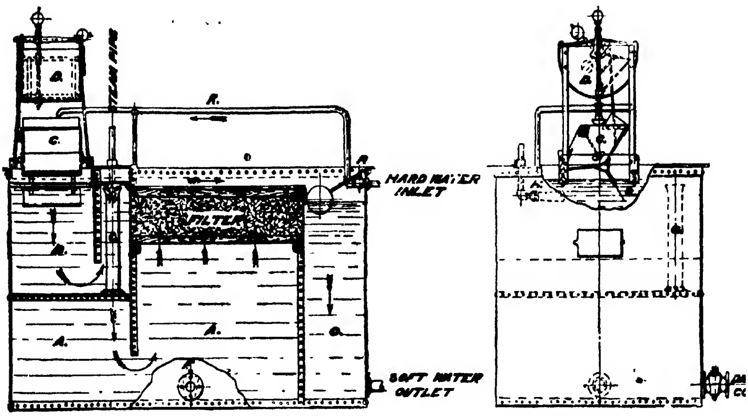


Fig. 92.

§556. The water to be treated runs from the pipe K into one of two chambers of an oscillating receiver C. A tank D, which is fixed above the receiver, contains the re-agents, mixed. The tank has a valve at bottom, and at every oscillation of the receiver this valve is opened by a system of levers, and an adjusted quantity of the mixed chemicals falls into the chamber of C that is filling. When the chamber is full the receiver overbalances, and the contents of the chamber pour into the tank B, the other chamber of the receiver being at the same time brought under the orifice of the pipe K. The settling tank and filter need mentioning simply.

§557. Intermediate between the tank B and the settling tank, the Bruun-Lowener apparatus is provided with a heating chamber, which is furnished with a steam nozzle for either live or exhaust steam, and in which the mixed water and chemicals can be heated before passing into the settling tank. Where steam is not available the softening process is of course cold throughout.

§558. The Doulton Water Softener.—Fig. 93 is a part section of one of the forms of this apparatus.

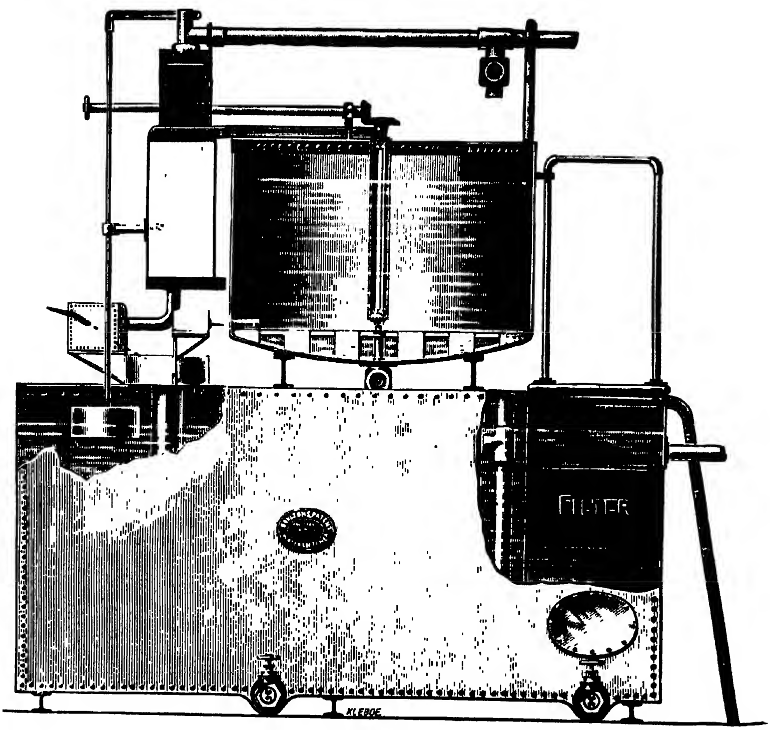


Fig. 93.

The tank at the bottom of the Fig. is the filter and storage tank. The small tanks, etc., immediately over, to the left of the Fig., are shown on larger scale in Fig. 94. The hard water enters through the ball valve that is seen over the water wheel, (Fig. 93), and passes into the tank G, (Fig. 94). The tank Y contains the mixed re-agents. The float W actuates the valve L, and a definite quantity of the re-agents is supplied at the mouth of the shute Q along with, and proportionate to the amount of the water that is passing from the tank G down the shute as the float rises. The outlet of the pipe R is at the bottom of the storage tank.

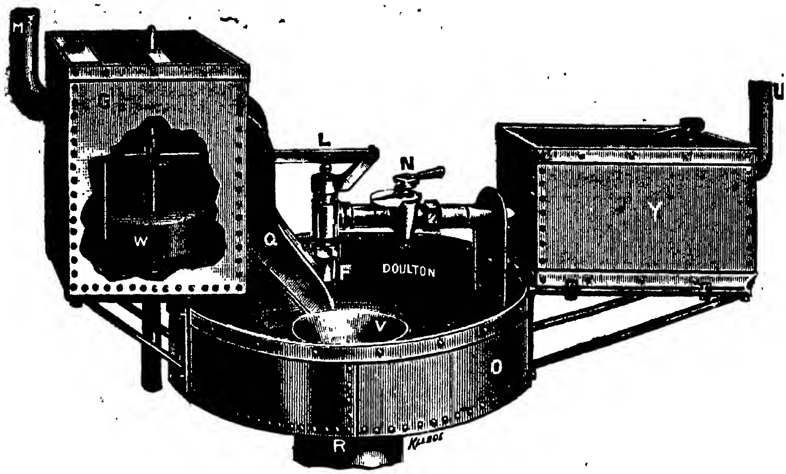


Fig. 94.

§559. In all three of the water-softeners described there are arrangements for stirring. In the 'Criton' softener there is in the lime-water tank a bed of slaked lime, and this is kept stirred by an agitator which is worked from the float of the syphon tank. In the Bruun-Lowener softener an agitator for stirring the water and chemicals is worked from the oscillating receiver. And in the Doulton, the re-agents are kept mixed by an agitator worked from the water wheel.

CHAPTER X.

STAINING, OR BRUSH DYEING.

§560. Instead of applying the dyes to leather by immersion in the dye-bath, they may be applied direct to the surface of the leather by means of a brush. The operation is commonly called staining. A strong solution of the dyestuff is employed.

§561. Almost all that has been said about dyeing applies to staining, but colours which dye well when applied in hot solution in the dye-bath are not always suitable for staining, owing to the fact that in order to stain well the colour must have a strong affinity as it were for the leather. Many colours which dye well when applied hot and with plenty of time to soak in, as in dyeing, are not taken up by the leather when applied cold and merely brushed on to the leather surface.

§562. It is when hides, kips, and large-sized and heavy goods are to be coloured that staining is usually resorted to; also when the flesh side of the goods is to be kept clean.

§563. Of late years several firms have been experimenting in the direction of dyeing hides in the paddle and the drum; the economy of the procedure is doubtful. The amount of dyestuff required, the smallness of the pack that can be treated at one time, and the fact that goods so dyed have generally to be topped with a solution of dye brushed on, are all in favour of the older method of staining being adhered to when hides and kips are operated upon. On the other hand many of the lighter kinds of

leather, such as hide shoulders and bellies, kip shoulders and bellies, basils, calf skins, etc., which are often treated by staining, might with economy be dyed.

§564. The staining operation is carried out mostly in the following manner:—After the preliminary operations of scouring (§§104-121), sumaching (§128), and setting (§590) have been gone through, the skins are usually dried out. The goods are then laid on a flat table, grain side uppermost, and the strong solution of dye, ½ to 1%, (2 oz. to 4 oz. per 2½ gallons), is rapidly brushed over the grain surface. In the case of small skins, such as basils, the brushing should be from the centre of the leather to its edges. In the staining of small skins one workman suffices.

§565. When small skins, such as Basils, are to be stained the common method is to place a pile of about one dozen skins on the staining table. The skin at the top of the pile having been stained, by brushing over with the solution of dyestuff, is removed and hung up to dry, and the next skin, now at the top of the pile, is then stained; this method being much quicker than is the case when the skins are laid one at a time on the table; there being no necessity to clean up the table for each individual skin.

§566. The staining of larger goods, such as hides and kips is generally gone through by two, sometimes three, workmen operating at the same time upon one hide. Standing both at the same side of the table on which the hide is placed the two stainers commence their work, one of them at the butt end of the hide and the other at the neck end. Each man stains a sort of square from the ridge to the edge of the hide, operating on from 18 to 20 inches at one time; the man who is at the butt end working towards the neck, and the man at the neck end working towards the butt. When half the hide has been stained

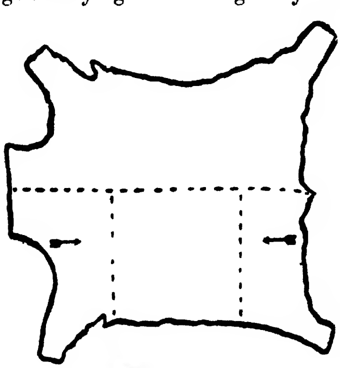


Fig. 95.

in this way the workmen walk round to the other side of the table, and then proceed to stain the other half of the hide. The Fig. 95 will explain the operation. The operation is somewhat different when three men operate on the hide at the same time. Two workmen commence staining in 'squares' as above described, the men standing one on each side of the table on which the hide has been placed, commence work at the butt end, both working towards the neck; the other workman standing at one end of the table commences to stain the neck end of the hide, brushing the neck and shoulders across from shank to shank. Fig. 96 shows the method ot working.

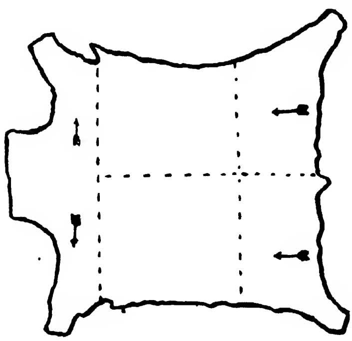


Fig. 96.

§567. The staining of a hide or kip is an expert operation. For it is obvious that if the two men do not work in unison, and do not each apply, square by square, about the same amount of dyestuff, the result cannot be a satisfactory one. Care must also be taken to as it were run the squares into one another so that there shall be no marks of junction, and that the hide shall show, all over, a perfectly level colour.

§568. After the application of one coat of the dye solution to the hide or kip it is hung up to dry, and when dry it is again laid on the table and receives a second coat of stain, applied in the same manner as was the first coat. If upon examination after the second drying out the shade is found to be insufficiently full, a third coat of solution is applied so as to obtain the required intensity of colour.

§569. Because of the time involved in the drying-out of the hides and the labour incidental to hanging up, the older method of giving the goods their first coat of stain when in the semi-dry condition has very generally been given up by stainers. There

can be no doubt, however, that it is a much better plan, instead of applying the colour solution to the dry leather, that the first application of the stain to the goods should be when they are in a sammed condition. A much more level colouring is attained when the first coat of stain is applied to the damp leather than when it is first received by the dry. As an alternative to the older plan it is advisable when the hides are dry after setting, to brush the grain surface over with water or with a very weak stain, (say ¼%) before applying the strong stain-solution.

§570. When bag hides and kips are being dressed, many manufacturers, after the sammying and setting, print on to the leather, by means of an embossed roller, the required bag-hide grain (see Chapter XVIII.) Or the printing is done when the goods have been damped back with water after setting and drying out. And the staining is proceeded with when the goods are dried out after the printing. This method of staining on the printed leather, though it is the common method and hall-marked by being old-fashioned, the writer does not approve; he is of opinion that it is wrong in principle and conducive to a dirty appearance in the finished goods. In the printing of the leather, the heaviest pressure is necessarily where the impress is deepest (see Sectional Fig. 97), and the pores of the grain in those places are closed up. Where the impress is superficial only, the pores of the leather remain open. The consequence is that when the stain is applied, the top surface of the imprint takes it up readily, whilst the bottom surface resists its penetration, the result being that the finished goods often present the smudgy, dirty aspect referred to. Much the better plan is to stain the goods before printing, and to print either after the last coat of stain, or to damp-in to a suitable condition the stained leather after drying, and then proceed with the printing.

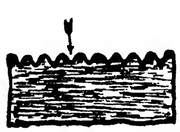


Fig. 97.

§571. Acid Colours in Staining. — Many of the acid dyestuffs (§330) are very suitable for use in staining; giving

clear regular colours. For light and medium shades of colour when regularity and freedom from bronzing (§320) are indispensable, the acid dyestuffs may be employed with great advantage. As the result of his experience the writer recommends that the goods should always be *bottomed* with an acid dye; the first coat of stain, that is to say, should be with an acid dyestuff, though the after brushings, two or three as may be necessary in order to obtain the depth of shade required, may be given with basic dyestuffs. The tendency earlier referred to (§303) of the basic dyestuffs to accentuate weak or defective grain is obviated by this procedure of bottoming with an acid dyestuff. The addition of sulphuric acid to the acid-dyestuff solutions must of course not be made, but a little formic, acetic, or lactic acid may be added to the solutions with advantage, the shade of colour being somewhat deepened thereby (§§331, 332), and the bite on the leather strengthened so that a more level result is produced. About from 1 to 2 liquid ounces of acid to each 2½ gallons of stain is a sufficient quantity to employ.

§572. Basic Dyestuffs in Staining.—The basic dyestuffs require as a rule no acid addition when employed for staining. The solutions used should be quite clear, and care is necessary that they contain no floating particles. In the event of a solution not being quite clear, as often happens with such dyestuffs as Bismark Brown, Vesuvine, Cannelles, etc., the solution should be filtered (§372). If the water available for dissolving is temporary hard (§524), an addition of acetic, lactic, or formic acid should be made (§369). The dyestuffs that do not readily dissolve should be moistened with one or other of the acids named (§376) before the boiling water is added to make the solution.

§573. The brushes suitable for staining vary according to the leather that is under treatment, but generally a brush that is moderately soft-haired, such as a shoe-polishing brush of good quality, can be advantageously employed. If the grain of the leather is somewhat coarse and open, the colour is more easily brushed in with a stiffer brush than that just named. When the

leather is smooth and absorbs the dye easily a sponge may be used instead of a brush, but the sponge is by no means so convenient or so suited to the purpose as the brush.

§574. If after applying a coat of stain to the leather any streakiness is noticed, or if any slight deposit has been left behind by the dye, it is advisable to rub the leather over with a damp sponge-cloth; the tendency to unevenness of colour indicated by the streakiness or deposit will generally be overcome by such procedure.

§575. It may be desirable to size the leather over before the first coat of stain is applied. This may be done by brushing the grain surface with a weak solution of some mucilaginous agent such as Irish or Iceland moss, linseed jelly, gelatine, farina starch, gum tragacanth, etc. (see Chapter XV).

§576. The object of such application is twofold. The primary reason for the procedure is to fill up defective grain, scratches etc., and thereby overcome the tendency to an exaggeration of the defects because of the dye being more readily absorbed in the defective places. Its other object is to keep the colour on the surface of the leather, and prevent a too deep penetration of the dye, the dyestuff being economised thereby.

§577. The most useful of the mucilages for the purpose are Irish moss, linseed, and algin, as these mucilages offer less resistance to the dye solution than do gelatine, starch, etc., as well as themselves dye much more easily. Suitable quantities for the purpose are ½ lb. Irish moss or 3 lbs. linseed, dissolved by boiling for some time in 10 to 15 gallons water; the solutions should be strained before use.

§578. The mucilage should be applied after the goods have been set, the application being made with a brush, and the leather afterwards dried right out before the application of the stain. When this plan is adopted it is unnecessary to damp the leather before applying the stain, as the sizing prevents a too rapid absorption of the dye by the leather.

§579. Bichromate of potash, as already mentioned (§466), is sometimes used as a darkening agent. It has the effect of darkening some of the dyestuffs, and of giving nut-browns by combining with the tannin of the leather. But it should be used with great caution, because of its oxydising the tannin matter of the leather. If however the leather is first prepared by being brushed over with a solution of cutch (§423), with which dyestuff bichromate of potash gives deep nut-browns, the danger of damage to the grain of the leather is much lessened, and moreover, better results in colouring are obtained.

§580. The common practice of preparing the leather when medium and dark shades of brown are to be stained, by a preliminary brushing over with a solution of iron, usually ferrous sulphate, (copperas, §444) is not dangerous if the leather is well tanned, and the iron solution is weak. A much to be preferred plan however is to bottom the leather with a stain, brushing the leather over with a weak solution of a suitable black or blue dyestuff, such as Napthylamine Black, or Nigrosine.

§581. With the coal-tar dyestuffs used alone, it is most difficult to match a pattern that has come about of coal-tar-dyestuff stain on an iron bottom, or of some iron salt having been added to the dyestuff used. By cutting the pattern, the stainer can usually tell whether it has been bottomed with iron, a light grey colour being observable on the cut surface where the iron has penetrated further into the leather than the dyestuff used for topping. If he finds such evidence of iron and his pattern has to be accurately matched, he is often compelled to resort, sometimes against his own wishes, to the use of an iron solution. When an iron salt is thus used, the leather should be previously either well sumached or treated with cutch, quebracho, mangrove extract, or some other suitable tanning material, (§443). A plan to be recommended instead of that of previous treatment with a tannin, is to apply the iron solution in the form of a weak ink in which the iron is already in combination with a tannin. A suitable ink for the purpose can be easily prepared by dissolving 5 oz. of copperas in

one gallon of water, adding 5 oz. of sumach extract dissolved separately in one gallon of water.

§582. Copper acetate (§472) is an excellent metallic mordant for use as a saddening agent, either in mixture with the dyestuff or by itself alone. With cutch, copper acetate gives good brown shades that are fast to light, and that only need a topping with a suitable coal-tar dyestuff to produce good commercial shades.

§583. Titanium salts (§455) may often be advantageously employed in staining, either as a bottom upon which to subsequently stain with basic dyestuffs, or in admixture with the acid dyestuffs (§330), and the acid mordant dyes (§360).

§584. For the convenience of those stainers who use potassium bichromate (§466), potassium chromate (§467), ferrous sulphate (§444), and copper acetate (§472) as dulling agents in admixture with coal-tar colours, a short table is given on page 205 of a few of the most common dyestuffs employed by leather stainers, together with particulars as to the manner in which they behave when mixed with the above-named mordants.

§585. The common plan of oiling the leather over on the grain side with cod oil after setting, and before drying out is never to be recommended; the slight greasiness thereby imparted to the leather often causing uneven colouring when the goods are stained. When the goods have been so treated, the addition of a small quantity of methylated spirits to the dyestuff solution is advisable. A good quality mineral oil is to be preferred for 'oiling off' after setting.

Dyestuff.	Potassium Chromate. (§467).	Potassium Bichromate (§466).	Ferrous Sulphate. (§444).	Copper Sulphate. (§471).
*Resorcine Brown, (Ber.) ...	No Precipitate.	No Precipitate	No Precipitate.	No Precipitate.
*Acid Anthracene Brown R., (By.) ...	,,	,,	,,	,,
*Acid Brown R, (C.)	,,	,,	.	,,
*Fast Brown G., (C)	,,	,,	,,	,,
*Fast Brown N, (B.)	,,	,,	.	,,
*Solid Brown O., (M.L.&B.)	,,	,,		,,
*Quinoline Yellow, (By.) ...	,,	,,	,,	,,
*Azo Acid Yellow, (Ber) ...	Precipitates	Precipitates	Precipitates.	Precipitates.
*Napthol Yellow S, (By.) ...	,,	,,	No Precipitate.	Precipitates slightly.
*Indian Yellow R., (C.) ...	Solution thickens.	Solution thickens.	Solution thickens.	Precipitates slightly.
*Azo Yellow, (W. t. M) ...	Precipitates.	Precipitates	Precipitates	Precipitates.
*Solid Yellow G., (Leon.) ...	,,	,,	,,	,,
*Curcumein Ext, (Ber.) ...	,,	,,	,,	,,
*Azo Flavine, (B.)...	,,	,,	,,	,,
*Cuba Yellow, (C)	,,	,,	,,	,,
Bismark Brown	,,	,,	No Precipitate.	No Precipitate.
Chrysoidine	,,	,,	,,	,,
Cannelle, (B)	,,	,,	Precipitates.	Precipitates.
Auramine	No Precipitate	,,	No Precipitate	No Precipitate.
Phosphine	Precipitates.	Precipitates.	,,	,,

* Acid Dyestuffs

§586. Mucilages such as linseed, starch, Irish moss, gelatin, gum tragacanth, etc. (see Chapter XV), are often used, for staining, in admixture with the dyestuffs themselves and the employment of such materials for thickening up the dye solution is good practice, as it is conducive to level staining, and also has the effect of preventing the dye from penetrating too deeply into the leather. Gelatin is much favoured for this purpose, especially in the staining of leather possessing much defective grain, such as kips for instance; linseed and Irish moss are useful for the same purpose. Care must be taken not to thicken up the solution too much, as with an over-thick solution, streaky and smeary results are likely to be obtained. The maximum quantities usually permissible for thickening up the dye solution are 1 lb. linseed, ½ lb. Irish moss, or ¼ lb. to ½ lb. gelatin, per 10 gallons of stain. The mucilage solution must be separately prepared, and added to the hot dye-solution, the mixture being allowed to cool somewhat before use.

§587. In staining, the dye-solution or dye-and-mucilage mixture is generally applied cold. It is better however to slightly warm the solution or mixture, a convenient temperature being 40° C. (104° F.), and there should be a suitable arrangement for keeping the temperature constant. Variation of temperature means often variation of colour in the pack of goods. Slightly warm solutions moreover, stain much more easily than cold solutions and produce fuller shades of colour, especially when the acid dyestuffs are being used. The method tends also to overcome a standing difficulty in the staining of leather, namely, its natural greasiness.

CHAPTER XI.

Striking-Out Machines.

§588. Goods after dyeing are 'struck-out.' The object of the operation of striking-out is to remove excess of moisture, to get rid of creases and wrinkles, and to equalise the texture of the skins by working uneven stretch out of them as far as possible.

§589. Goods are struck-out at various stages of the leather-dressing process, (see §107), and usually both before dyeing (§219), and after. In striking out by hand, in the case of sheep, calf, and goat skins, half the skin is laid on a table, the other half hanging over the front of the table (Fig. 98), and the workman, after first slicking-off all surplus moisture from the skin, works it with his slicker from neck to butt, working the lengthways of the skin, and then from the ridge to the shanks and belly. Having worked over the one half of the skin in this way, he turns the skin and works the other half, (see §107). When coloured leather is being worked, brass or vulcanite slickers are to be preferred.

§590. To construct a machine that would satisfactorily do the work of striking-out called for the exercise of considerable ingenuity, and skilfulness has been brought to bear on the task with a large amount of success. An outcome of its exercise we have already seen in the Fitz-Henry and Jackson Scouring Machine (§§112, 113), which becomes a Setting-out Machine

Fig. 98.

when its head (Fig. 48) is fitted with slickers instead of stones. In the setting-out of curried goods the machine is of the greatest utility and it is largely employed for that purpose. Further description than that which has already been given is unnecessary, the machine not being suitable for the setting-out of dyed skins.

§591. Later machines various for setting-out, (or 'putting-out,' as it is sometimes termed), are on the market. Of the greater part of these the essential feature is that the skin to be set is horsed on to a table, and, along with the table, is carried between two rollers revolving in opposite directions, and, each of them in the direction that resists the progress of the table. The rollers are furnished with slicker-blades, arranged spirally on them, right and left hand, (see Fig. 31), and these blades, resisting the progress of the skin, do the work of setting out.

§592. As may well be supposed, with a skin horsed on to a table to which motion has to be given, and on both sides of

which work has to be done, a vertical movement for the table is the first that would suggest itself; and as a matter of fact, the striking-out machine first introduced (by J. W. Vaughn in 1882, (Patent No. 5936), was a vertical-table machine. It is shewn in Fig. 99 as now on the market. Another vertical-table machine is illustrated in Fig. 100, and Fig. 101 is a vertical transverse-section of it. F is the table and D, D, are the revolving rollers. The moving of a lever starts the table on its travel upwards. It returns by its own weight, under control of a brake. A lever operated by the foot gives the requisite pressure on the skin.

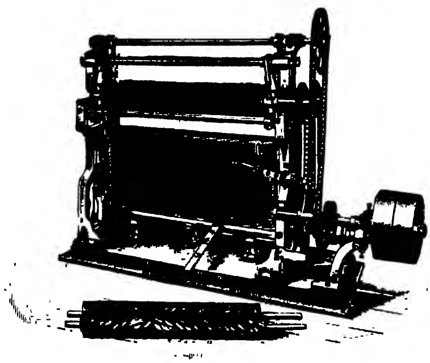


Fig. 99.

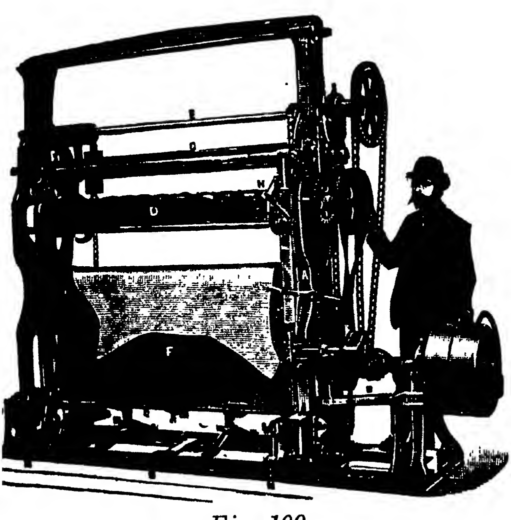


Fig. 100.

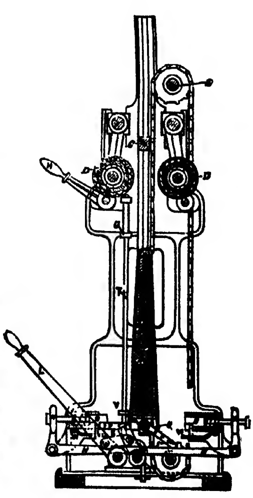


Fig. 101.
Sectional Drawing of Vertical-Table Machine.

§593. The skin being horsed on the table with the ridge of the skin along the top edge of the table, it is evident that the ridge does not get worked-on by the rollers during the travel of the table. When therefore the table is back in the position from which it started, the skin is shifted some two or three inches upon it, and the ridge is set-out by a second travel of the table between the revolving rollers.

§594. The machines are usually operated by a man with a boy assistant; the boy stands behind the machine. During the travel of the table and skin upwards between the setting-out rollers or cylinders, the operator and his assistant, the former on one side of the table and the boy on the other side, guide the skin by taking hold of the shanks and placing them in position as the striking-out is proceeding. Dependent on the class of skin that is being worked one of these machines will set-out from 90 to 100 dozen skins per day.

§595. The automatic shifting of the skin in order that the ridge should be set-out, instead of shifting it by hand, was evidently a desideratum; also that for the working of the ridge, there should be no need to bring the table back to its starting position; and machines are now on the market that effect these objects. The machine shown in Fig. 102 is one of these; it both shifts the skin automatically and sets-out the unworked ridge without return of the table. For the setting-out of the ridge it is furnished with a second pair of rollers. And the machine does still more. As will be seen from the illustration it is fitted with 3 tables, each of which carries a skin, and the travel of these is not between a pair of striking-out cylinders and then back again, but continuous. A skin placed on a table is carried up, passes between two rollers, is automatically shifted on its table, has a second setting-out by the second pair of cylinders, and then is carried to the back of the machine to be taken off and replaced by another skin. The output of one of these machines is enormous, being from 150 to 300 dozen skins per day. But the machine has the defect that the skins are not struck

out to the same degree of perfection as on a one-table machine, for there is no getting at the tables, from the back, whilst the skins are passing through the rollers, and no manipulating the skins therefore as they are manipulated by the operator's assistant at the one-table machine.

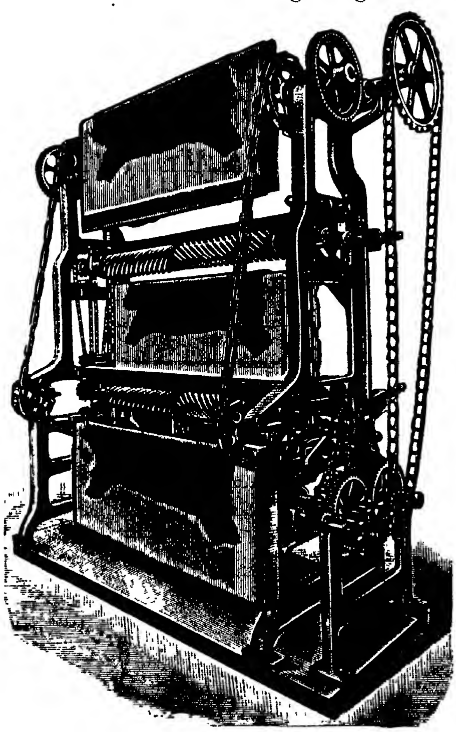


Fig. 102.

§596. Fig. 103 shows another machine of like character to the foregoing, but with horizontal, not vertical travel. It has tables. The defect of the back of the skin being inaccessible during its progress between the cylinders exists here also. It is a useful machine when heavy leathers, hides, and kips are being treated.

§597. It will be seen by a reference to Figs. 99 and 100, that the dividing line of the right and left-hand spiral blades on the cylinder is not central, but is so situate as to correspond to a line drawn across a skin behind the shoulders, to the line across the skin, that is to say, that is *essentially* the central line of the skin.

§598. Fig. 85 represents quite another type of setting-out machine. The machine was originally introduced for unhairing and fleshing previous to tanning, but it has been more successfully adapted for striking-out. A noticeable feature in it is the

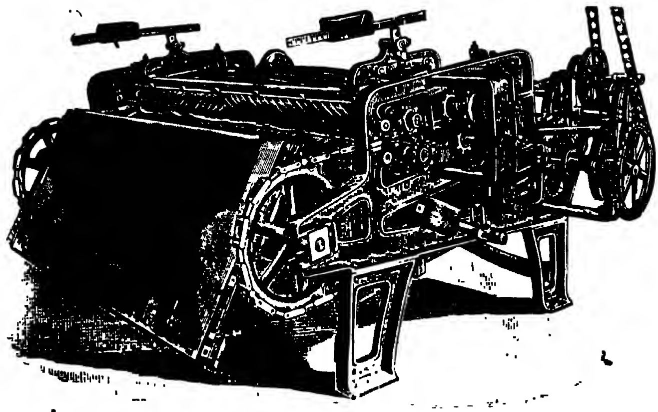


Fig. 103.

half-cylinder. Over an edge of this the skin is thrown, and is held in position by a nipping bar. The machine being started, the semi-cylinder rotates, and the skin, which is on its outer periphery, is carried under the bladed setting-out roller. (The machine has but the one roller). Half the skin is now struck-out. For the setting-out of the other half the position of the skin is changed; the worked half hangs over the edge of the semi-cylinder into the hollow of it, and the unworked half receives the action of the setting-out roller.

§599. Since the first edition of this book was published, an improvement has been made in the drum type machine. This consists in the substitution of the long spiral bladed cylinder shown in Fig. 85 by a short cylinder, as shown in Fig. 104, which has the distinctive feature that it can be moved forward or back across the face of the working drum while the latter is revolving under it, and the leather is being treated. This cylinder is fitted with the common spiral blades, and the machine possesses the advantage, especially in working odd-shaped and narrow pieces of leather, such as bellies and shoulders, that the central division of the cylinder can always be kept in the centre of the work piece. Consequently, the stretch each side of the centre is equal, with the result that the leather is stretched more in the direction of the width.

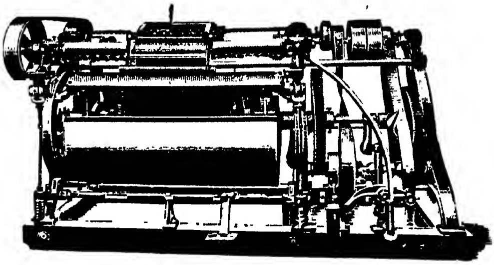


Fig. 104.

§600. The output per day of this machine is but small, and will not bear comparison with that of the vertical-table machine, but it does excellent work. The advantages of the machine are that the goods are fully under observance by the operator and he can arrange a skin as he pleases whilst it is being set-out. The machine is very useful upon heavy leathers, such as kip shoulders, butts, etc., and specially serviceable in striking-out curried leathers after drum stuffing.

CHAPTER XII.

Fat Liquors and Emulsions, and their Application.

§601. Since the advent of chrome leather, fat liquors have been used by leather manufacturers to a much greater extent than before that time; latterly fat liquors have been employed with advantage in the manufacture of leathers for shoe purposes principally, such as shoe-calf, blue-back glacé sheep, goat, etc.

§602. The fat liquor for the leather manufacturer should be an emulsion. Oil suspended in water, or made to combine with water by some substance that has the property of combining with both, is by no means necessarily an emulsion. For any such mixture to be an emulsion, the oil must be held in suspension in small particles which do not coalesce; which do not, that is, two or more of them, unite into one. This non-coalescence is the *sine quâ non* of an emulsion, and if there is any coalescence the emulsion is imperfect, more or less according to the extent of the non-coalescence.

§603. Manufacturers who have had experience in fat-liquoring, and especially in the employment of a fat liquor upon chrome tanned leather, well know that a properly emulsified fat liquor is an indispensability when first-class finished products are desired. Perhaps most of the difficulties which have been met with in the manufacture of chrome leather may be traced back to the fat-liquoring. Skins which are over fat-liquored are often difficult to deal with in the finishing, whereas goods which have been under fat-liquored are apt to possess a 'tinny' feel, and to lack the softness and plumpness possessed by a properly fat-liquored skin.

Goods which have been treated with a fat liquor that has not been properly emulsified are frequently troublesome in the glazing. The writer has seen skins with patches on the grain surface which would not glaze. The oil in the imperfectly emulsified fat-liquor had settled itself in the patch places instead of distributing itself evenly over the grain surface of the skins; this being what happens when the emulsification is thorough.

Fig. 106.

§604. The ideal emulsion is milk, which consists of water, and about equal percentages of fat and emulsifying agents, together with sugar and inorganic salts. Milk contains on the average 3·4 per cent. of fat, 3·5 per cent. of proteids, (albumen and casein), 5 per cent. of milk-sugar and 0·6 per cent. of inorganic salts, the

remainder being water. The emulsifying agent in the case of milk is casein; and it would seem as if each particle of fat had a thin outer layer of proteid, so that demulsification, (coalescence of the fat particles), is a matter of difficulty. The emulsions which are used in leather manufacture contain, of their very purpose, more fat than milk contains; but when making an emulsion the ideal should be kept in view, because, for good work in leather, an emulsion in which the fat globules are not visible to the naked eye is a desideratum.

§605. The majority of the emulsifying agents employed by pharmacists when making emulsions of cod-oil and other oils for medicinal purposes, are unsuitable in making oil emulsions for fat-liquoring leather. The emulsifying agents of the pharmacist, gum acacia, gum tragacanth, etc., are required in such quantity in fat-liquoring emulsions for leather, that the leather treated is very appreciably hardened or stiffened, and the softening action of the oil in the fat-liquor is neutralised.

§606. Egg-yolk, which is itself an emulsion, consisting of about 28 to 30 per cent. of fat, together with from 16 to 18 per cent. of vitellin, (a substance closely resembling the casein in milk both in properties and composition), acts admirably as an emulsifying agent for neatsfoot oil, as also for castor, cod, sperm, olive, cottonseed, and linseed oils. In the case of either of these oils it is possible by the addition of a suitable quantity of egg-yolk to produce an emulsion that will stand for several days without any trace of the oil separating itself. And if soap is added to the mixture in quantity sufficient to make it semi-liquid, an emulsion may be prepared in a concentrated form that will last for some months. The emulsifying agent in egg-yolk is the vitellin. Preserved egg-yolk which contains salt is unsuitable when soap is a component of the fat-liquor. Soap being insoluble in a weak salt solution separates out, and the mixture is then an imperfect emulsion.

§607. Casein also acts admirably as an emulsifying agent; but, writing for leather manufacturers, it is hardly necessary to

point out that egg-yolk is preferable; seeing that, apart altogether from its emulsifying property, egg-yolk is of itself an excellent 'feed' for leather.

§608. The proportion of egg-yolk to oil that I have found give the best results is, 5 to 6 egg-yolks to each gallon of oil. The leather manufacturer may add the egg-yolk to his fat-liquor as he at present prepares this. By way of illustration however I subjoin some recipes for fat-liquors. (See also §§638, 639, pages 227 and 228.)

§609. FAT-LIQUOR RECIPES.

CHROME CALF.

1 gallon Castor Oil.
3½ lbs. Soft Soap.
½ lb. Egg Yolk.

CHROME KID.

1 gallon Neatsfoot Oil.
3½ lbs. Soft Soap.
½ lb. Egg Yolk.

CHROME KIP SIDES (BOX.)

1½ gallons Castor Oil.
5 lbs. Soft Soap.
½ lb. Egg Yolk.

CHROME KIP SIDES (DULL.)

1½ gallons Neatsfoot Oil.
½ gallon Sod Oil.
2 ozs. Washing Soda.
6 lbs. Soft Soap.

COMBINATION CHROME.

1½ gallons Castor Oil.
1 lb. Vaseline.
5 lbs. Soft Soap.
½ lb. Egg Yolk.

VEGETABLE TANNED CALF, ETC.

2 gallons Sod Oil.
6 lbs. Soft Soap.
1 lb. Egg Yolk.

§610. In preparing a fat-liquor emulsion it is best to dissolve, by boiling, the required amount of soap in as small a quantity as possible of water, (1 gallon of water to each 3 lbs. of soap may be taken as a sort of standard), to then add the requisite amount of oil, and then for a few minutes to boil the ingredients both up

together. The mixture should now be transferred to the emulsifier, (Figs. 106, 107) and the incorporation completed in the machine. When the temperature of the mixture has fallen below 35° C., (95° F.), the egg-yolk, previously mixed up with a little tepid water, should be added, and the whole then thoroughly agitated in the machine until a perfect emulsion has been obtained.

§611. The quantities given refer to 300—400 lbs. of leather struck out ready for fat-liquoring, and it will be found, on making any of the above fat-liquors, that when cold they will set into a semi-liquid condition. The advantage of this is apparent: it being possible to thus obtain at one making-up sufficient fat-liquor to treat the goods intended say for a week's manufacture, and to measure out the concentrated liquor in the quantity required, and as required; a much better method of proceeding than that of having to make the fat-liquor for a pack of goods just before they are treated. It will be found, if the emulsification has been properly performed to begin with, that the concentrated liquor will mix with warm water without any separation whatever of the fat particles.

§612. In order to obtain a good emulsion some piece of apparatus is required which will separate the oil into particles, so that the egg-yolk can accomplish its object. The writer has found the apparatus here illustrated (Fig. 106) thoroughly efficient, when only hand power is available. The apparatus is one commonly employed by pharmaceutical chemists in making emulsions in cod-liver oil, &c., for medicinal purposes. It is made of tin, and is 36 ins. high and 8 ins. in diameter. For the purposes of the leather dresser, a somewhat larger size may be employed with advantage; the proportions however should be retained, these being the outcome of the test of experience.

§613. The fat-liquor mixture, after having been dissolved in hot water, is placed in the emulsifier and the plunger is worked up and down; the operator in the illustration is thus working the

plunger. Care must be taken in this working not to lift the plunger above the surface of the mixture, as the bringing-down of the plunger on the mixture-surface after such a lift causes splashing. The working of the plunger should be continued for a quarter of an hour, or until complete emulsification has taken place.

§614. When large quantities of fat-liquor are required, a machine driven by power is a necessity. Fig. 107 shows such a machine. It consists of a jacketed pan fitted with a stirring arrangement of blades or vanes on a vertical shaft, the action of these blades, which are portions of a supposed-continuous screw-thread, being similar to that of the blades of a screw-propeller. The pan further has stationary arms not shown in the illustration, fixed to its sides. The screw-blades are provided with sluice holes. When the machine is started, a violent current is set up in the fat-liquor mixture that has been placed in the pan. This current the stationary arms break, and there is brought about in this way a sort of rubbing one upon another of the particles of the mixture, which frictional action is intensified by the agency of the sluice holes in the blades or vanes, so that the mixture is thoroughly disintegrated, and an excellent emulsion is produced.

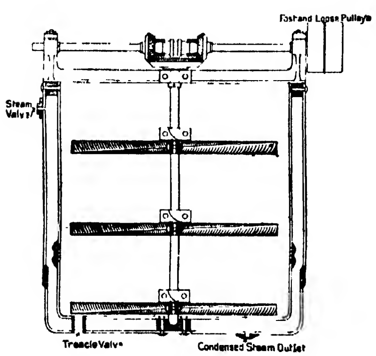


Fig. 107.

§615. The use of a hard (soda) soap is, generally speaking, not to be recommended in fat-liquoring operations, especially when a maximum of softness in the finished leather is required. A hard soap cements the fibres of the leather together as it were, particularly if there is an excess of the soap. The resulting

finished leather is flat, and devoid of the plump, soft, elastic feel that a properly fat-liquored leather possesses, and this is markedly the case if the goods are subjected to heavy pressure in glazing.

§616. The soap that is a component part of a fat-liquor should be a soft (potash) soap. Soft soap has not the tendency just above mentioned to harden the leather treated, even if by mischance the goods are over fat-liquored. Soft-soap oil emulsions are besides easier to prepare than hard-soap emulsions.

§617. The preparation of a soap for fat-liquoring is an operation that can be carried out by the leather dresser himself with very little trouble, the neutralisation of fatty acids (oleaginous materials) by caustic alkali being an extremely simple operation. And the advantages of his preparing it for himself are many. The resulting product is invariably uniform in character; the user knows what kind of soap he is employing, whether it is a tallow soap, or an olive, or castor, or other oil soap; and he further knows that the soap he has prepared is free from the common adulterants of commercial soaps, resinate of soda, sodium silicate, &c., which have a detrimental effect on the leather.

§618. The 'cold-process' (as it is termed) making of soap is carried out by mixing together in an open vessel, the fatty material that is to be saponified with the amount that is necessary of soda or potash ley. The mixing must be thorough, and when it has been carried through, the mixture must be allowed to stand until the saponification reaction is complete.

§619. The requisite quantity of melted fatty matter, or oil, at a temperature of about 40° to 45° C., (104° to 113° F.), is placed in a wooden tub, the soda or potash ley is added, and the mass is stirred with a flat wooden stirrer until the ingredients are intimately mixed and of a paste-like consistency. The mixture is then run out into a shallow wooden vessel, and left for some hours in a warm room until a thorough saponification has taken place. The soap is then generally ready for use. The mixing of the fatty

matter and the soda or potash ley is most conveniently carried out in some apparatus that possesses a mechanical agitator, such for instance as that above described (Fig. 107) for use in the preparation of fat-liquors.

§620. The following are the quantities of potash or soda required when making a soft or a hard soap, per 100 lbs. of fatty material:—

Fatty Material.	Caustic Potash. (For Soft Soap).	Caustic Soda. (For Hard Soap).
100 lbs. Tallow	20 lbs.	14¼ lbs.
100 " Neatsfoot Oil	19 "	13 "
100 " Linseed Oil	19½ "	14 "
100 " Palm Oil	20 "	14¼ "
100 " Castor Oil	18 "	13 "
100 " Cocoanut Oil	25 "	18 "
100 " Olive Oil	19½ "	14 "

The alkali in each case is dissolved in 5 gallons of water.

§621 When soft soap is being prepared from olive, castor, palm, or other vegetable oil, a little tallow or stearic acid is often added, in order to bring about a granular appearance, known as 'figging,' in the completed soap. Such granular soaps are often called 'fig' soaps, and pretentiously put forward as being of superior quality, a statement of claim that must be taken with the proverbial grain of salt.

§622. The prepared soap should be quite neutral in character; this is, for most purposes of leather dressing, very desirable. It should dissolve in pure water to a clear solution, free from floating globules of oil; and the solution should not show alkalinity, (denoted by a deep red colouration), when a few drops of an alcoholic solution of phenol-phthalein are added to it.

§623. The fat-liquoring of the goods under treatment is usually done in the drum. In some special cases the application of the

fat-liquor is by brushing it on to the leather. Fat-liquoring is one of the most important operations in leather dressing, especially when chrome and combination-chrome leathers are being dealt with. Bad fat-liquoring results in a greasy leather, to which it is difficult to give a glaze finish. Under fat-liquoring brings about a leather usually hard and stiff, except when vegetable-tanned leathers naturally soft are being treated. If the fat-liquoring operation is indifferently carried out, there is a liability of the liquor being unevenly distributed through the leather, so that it is greasy, more or less, in patches, particularly so where the leather is thin.

§624. The best form of drum for the purpose of fat-liquoring is that now well known as the hot-air stuffing-drum. It is used to drum-stuff leather in currying. A type of such drum is illustrated in Fig. 108. The subject of 'drum-stuffing' is dealt with in Chapter XXVI.

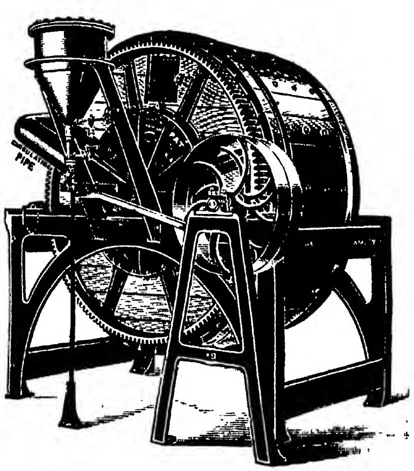


Fig. 108.

§625. Just as essential as when drum-stuffing is being done is the warming of the leather before the introduction of the fat-liquor into the drum. With cold goods and a cold drum, both at once, there is a liability of the fat-liquor being chilled. When cold goods come into contact with a warm fat-liquor, the soap in the liquor solidifies on or near the surface of the leather, and further penetration, of the liquor, its penetration, that is, to the centre of the leather is prevented. Goods, especially chrome-leather goods, will become greasy

on the surface without there having been a lubrication of the fibres in the interior, and the finished goods will doubtless be 'tinny.' With warm leather, a hot drum, and of course a hot fat-liquor, it is possible for the goods to take up without there being any resultant greasiness in the leather, nearly double the amount of oil and soap that can be absorbed when the hot fat-liquor is run into a cold drum, and the goods are cold or only barely warmed. When a stuffing-drum proper is not available for warming the goods, the ordinary drum may be used for that purpose. The drum should be heated by the blowing-in of steam for from 20 minutes to half-an-hour, until the drum is heated to about 48° C., (104° F.); the water of the condensed steam should then be allowed to run off, and the steam to escape from the drum interior; and the struck-out or sammed goods should then be entered. After a drumming of about five minutes in the heated drum the hot fat-liquor should be run in.

§626. The concentrated fat-liquor emulsion made use of should not be large in quantity, just sufficient with the necessary added water to furnish a small pool of liquor at the bottom of the drum for the goods to fall into in the drumming. An ample amount of liquor would be from 10 to 15 gallons for every 100 lbs. weight of leather, the quantity being decreased *pro rata* for larger packs of goods and somewhat increased for smaller packs.

§627. The diluted fat-liquor emulsion should be run into the drum through the hollow axle at a temperature of about 45° C. to 48° C., (113° F. to 118° F.) in the case of vegetable-tanned goods, and at a higher temperature, from 50° C. to 55° C., in the case of chrome-tanned leathers. The drumming in the fat-liquor should be continued for about three-quarters of an hour, by which time the goods should have absorbed the whole of the fat, leaving behind in the drum a small quantity of more or less dirty water.

§628. When fat-liquoring dyed goods with a soap and oil emulsion, the quantity used of the concentrated fat-liquor emulsion should be the smallest possible. If the goods are

drummed round in a comparatively large volume of liquor a considerable amount of the dye will be stripped from the leather. When dyed goods are to be fat-liquored, it is a useful plan to add some fat-liquor to a little of the partially exhausted dye-bath, or to colour the fat-liquor solution itself by the addition of a small quantity of dyestuff, (of course previously dissolved), similar to that with which the goods have been dyed.

§629. SULPHATED OIL, commonly called Turkey red oil, can be used as an emulsifying agent, and can be substituted for soap as an ingredient in a fat-liquor. Indeed it is being largely used in America for fat-liquoring the cheaper kinds of leather without any addition.

§630. Sulphated oil is prepared by adding a calculated amount of sulphuric acid to a definite quantity of castor or olive oil. The addition is a comparatively simple operation requiring no expensive plant.

§631. According to J. A. Wilson (Jour. Soc. Chem. Ind., Jan. 1891) the manufacture is carried out as follows:—'The first operation takes place in rectangular wooden vessels occasionally lined with lead and preferably fitted with an apparatus for agitation of the contents of the vats. These vats are fitted with stop cocks at suitable heights in order to run off the wash waters and the finished products. Castor oil is run into the wooden vessels and the contents gauged. The proper quantity of oil of vitriol is then slowly added, the whole contents being thoroughly agitated by means of the apparatus, or in default of this by large paddles made of wood. The amount of vitriol used varies from 15% to 40% of the weight of oil, being most in winter and least in summer, and both of which differ according to the practice of the manufacturer. Again some manufacturers add the whole of the vitriol at one time, others at two periods, half on one day and the other half on the day following. The temperature is not allowed to get too high or a dark coloured product is produced.

'After allowing to stand for 12 to 24 hours, the mixture is ready for washing, which is done with hot water or a salt

solution in order to reduce to a minimum the loss of oil due to solubility. Some manufacturers work first with ordinary water and finally with the salt solution.

'In washing with salt solution it is important not to commence with too hot a solution, otherwise the excess of vitriol produces chlorohydric acid which decomposes the sulphated oil, and this is simply undoing what we have already done. After the washing comes the neutralizing which is only done partially. Soda or ammonia are employed, the latter is to be preferred although soda is more generally used.

'Water is then added so as to make a finished product containing from 45% to 50% fatty matter; occasionally much less water is added.

'In producing high class Turkey red oils much more trouble is taken but the above is the general method of procedure generally adopted.

'In summer time Turkey red oil occasionally decomposes, separating into fatty matter and water together with an odour of fermenting.'

§632. Turkey red oil can be made on a small scale by the leather dresser himself. The writer has himself made the oil in small quantity. The castor oil, 7½ lbs. suppose, of the oil, at a temperature of as nearly as possible 15° C. (60° F.), is poured into, say an ordinary pail, and to the oil is added 1¾ lbs. of sulphuric acid. The oil must be kept always in motion during the addition of the acid and the acid be very slowly added, the addition extending over quite half an hour. When this is completed, the mixture should be well and vigorously stirred for at least 15 minutes, and then should be covered up and allowed to stand for 24 hours. A sample now taken and added to about 100 times its volume of water should dissolve quite clear with the assistance of a few drops of ammonia. If the oil does not dissolve in the water, a little more sulphuric acid is required to

be added to the mixture in the pail. It is permissible to add ½ lb. more acid, but if the operation just described has been carefully carried out the addition will usually not be necessary. The further acid must be added with all the precautions mentioned, and the mixture again allowed to stand for 24 hours. Test should then once more be made in order to ascertain whether it is or is not soluble in water.

§633. Enduring the test, the mixture is now washed with water equal to itself in volume and allowed to stand until the oil has come to the top, when the watery solution is carefully syphoned off, and a second washing is made, the water and oil being well mixed, allowed to stand as before, and the watery solution again syphoned off. The washing is now a third time gone through, the mixture thoroughly agitated by stirring, and the water drawn off after the oil has separated. To the oil should now be added 1 oz. of concentrated ammonia, and the oil and ammonia being well stirred, the mixture should be ready for use.

§634. Irrespective of its utility as an ingredient of a fat-liquor, Turkey red oil possesses the property of forming insoluble colour lakes with basic colours (§322), and it can in consequence be used as a fixing agent for this class of dyestuff, the application being made either before or after dyeing. Turkey red oil forms insoluble compounds with metallic salts (§441), which can be produced on the fibre of the leather (§635).

§635. Soaps also form insoluble compounds with metallic salts, and both soaps and Turkey red oil form insoluble compounds with alkaline carbonates, (§533). When vegetable-tanned goods are to be fat-liquored with a soap-and-oil emulsion, it is desirable to prepare the leather for the fat-liquor by preliminary treatment with a suitable metallic salt, in order that the insoluble metallic soap mentioned may be produced on the leather fibre. Such treatment imparts a perceptible waterproofness to the leather, and the fat-liquored skin will moreover retain the softness and pliability that this imparts for a much longer period than if the skin had

been simply fat-liquored without the preliminary treatment. Aluminium acetate, copper acetate, (§472), or chromium acetate, may be used for this preliminary treatment. When acid dyes are employed in the dyeing, these salts, either of them, may in the majority of cases be added to the dye-bath itself, the addition being made towards the end of the dyeing, the goods after dyeing being washed up and struck out in the usual way and afterwards fat-liquored.

§636. The washing up after the treatment with the metallic salt is essential in order to clear the grain side of the skins from excess of the salt, as the metallic soap would otherwise be precipitated on the grain of the leather, and as mentioned, the compound is extremely insoluble, sticky, and difficult of removal by mechanical means.

§637. The addition of glycerine to a fat-liquor serves no useful purpose, though such addition has often been advocated for chrome leather, the claim being that its addition assists in the damping-back of the goods for the operation of staking (see later Chapter); the wetting-back of thoroughly dry chrome leather being difficult, if not impossible. Glycerine is very hygroscopic, has a great affinity for water, that is. Hence its addition to the fat-liquor emulsion is of little value; the greater part of the glycerine, (upwards of 85 per cent. in cases that have come under the author's notice), being left in the waste water after fat-liquoring. If glycerine is to be used for the purpose mentioned, it is best to apply it direct to the goods when struck-out after fat-liquoring, the application being made with a brush or sponge, and a diluted solution of glycerine being employed, say of 1 part glycerine to 3 parts water. Goods after fat-liquoring should be carefully horsed up for a few hours previous to the striking-out ready for drying.

§638. An emulsion of Farina (§772) and oil partially saponified with alkali, has been advocated* as a fat-liquor, and such a fat-liquor is useful for many purposes. The fat-liquor is

*Dreher, *Leather Trades' Review*, July 1903.

prepared by dissolving 3—4 ozs. of washing soda in one gallon of water and adding 3—4 ozs. farina which has been previously soaked in cold water, and, finally, one quart of castor oil. The mixture is now heated to a temperature of about 50°C. (122°F.), 4½lbs. Degras added and the mixture well emulsified. This fat-liquor must not be boiled.

§639. As a substitute for soap in the preparation of a fat-liquor, sodium alginate (§742) may be employed. A suitable algin fat-liquor is prepared by dissolving 2 ozs. of washing soda in one gallon of water, adding 2 lbs. of Algin paste and warming the mixture gently until the Algin has quite dissolved. 3 lbs. of castor oil or degras is now added and the mixture boiled for five or ten minutes and well emulsified, finally adding 3 egg yolks mixed up with a little cold water after the mixture has become nearly cold. The fat-liquor is afterwards re-emulsified.

§640. When fat-liquoring goods to be glazed, castor, olive or neatsfoot oil are to be recommended for use. If the goods are to be finished dull, such as chrome memel, chrome for picker bands, dull chrome, etc., the use of degras or sod oil is to be advocated either alone or in conjunction with neatsfoot or olive oil.

§641. Many manufacturers give their goods a preliminary fat-liquoring after the preparatory processes preliminary to dyeing (§118, §133) and then dry out the prepared and fat-liquored goods, before proceeding with the dyeing. Such a method is good practice, particularly in the case of calf, Persians, etc., to be dressed for shoe upper leather.

§642. The goods after being tanned, sumached and fat-liquored, are set out and dried. It is possible when this method is adopted to prepare a large stock of leather at one time and thereby always have a quantity in hand in such a condition that when required they may be dyed at short notice; the skins simply requiring wetting down in water before being placed in the dyebath. Goods which have been prepared in this way dye well even after long storage and are always soft and mellow; a little extra fat-liquor may be given to the goods after dyeing if found necessary.

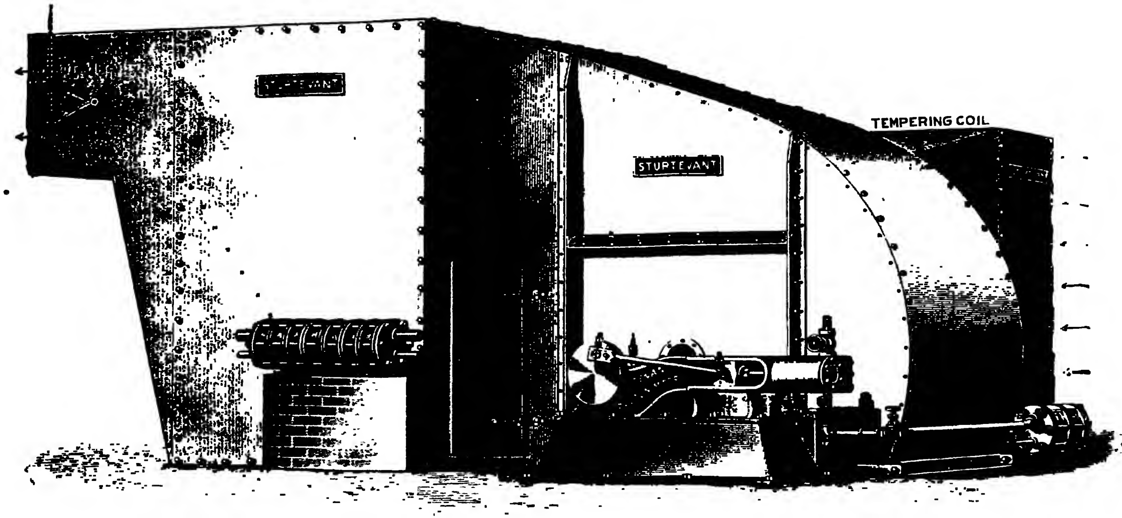


Fig. 109.—Sturtevant Drying Plant.

CHAPTER XIII.

'SAMMING' AND DRYING.

§643. SAMMING.—To 'sam' leather is to get it uniformly half-dry; this semi-dryness being an essential condition for the leather to be in when it is to be shaved, (§62), split, (§28), fat-liquored, (§601), or curried, (see Chapter XXVI). A sammed condition of the leather is also requisite for other operations upon it. Until recently, goods requiring to be sammed were hung up in a drying room, (§659) until dry enough for the work to be done upon them. Especially were goods thus treated when they were to be 'highly-sammed,' that is, only a small amount, comparatively, of moisture to be left in them. The thin parts which had become too dry of the sammed leather were afterwards damped back with water

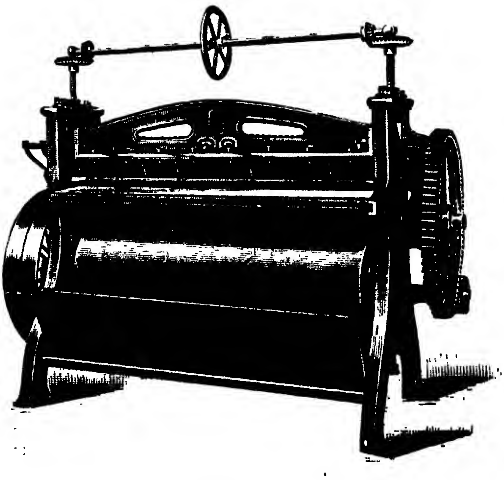


Fig. 110.

applied by a brush, and the goods finally placed in pile so that they should become uniformly moist throughout, and protection against drying whilst uniformity of moisture was being secured, was afforded by covering the goods with wet bagging.

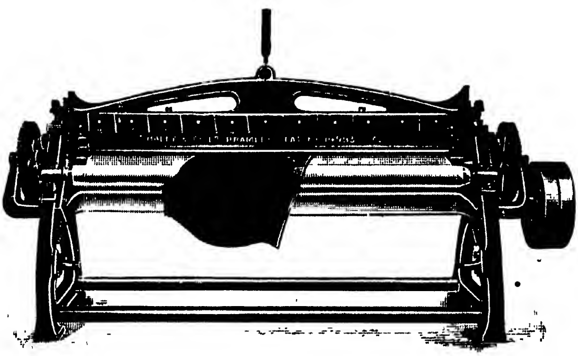


Fig. 111.

§644. At the present time, however, the samming of leather goods is largely done by machine. A type of samming machine is shown in Figs. 110, 111, and the machine much resembles a band-knife splitting machine without the knife, and can be quite understood by a reference to Fig. 8, p. 17. It has a nipping roller F with supporting roller G, and a sectional roller E, beneath which is a rubber-covered roller D. The arrangement of the rollers is not quite as represented in the Fig., D being directly under E, and G to the left-hand side of F, but essentially those four rollers constitute the machine.

§645. The leather to be sammed is passed between the rollers F and E, and subjected as it passes to the pressure necessary to remove excess of moisture and get it into the required sammed condition. There is provision made in the machine for regulating the pressure of the nipping roller; and the sections of the sectional roller, supported by the rubber underneath, provide for

inequalities of thickness in the goods. In the machine, Fig. 111, the rubber roller is dispensed with and the sectional roller is driven by gearing from both ends of the machine. A trough at the base of the machine receives the squeezed-out water.

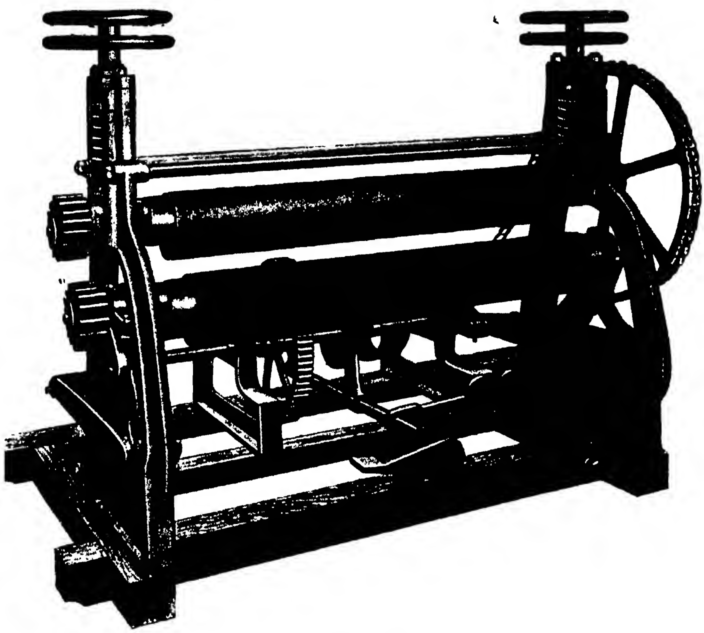


Fig. 112.

§646. Another type of samming machine is illustrated in Fig. 112. In this machine the skin to be sammed passes between the rollers from the further side, and a spiral-bladed knife behind the lower roller (not seen in the Fig.) sets out the skin as it reaches the rollers. In machines not thus furnished the skin has to be fed carefully up to the rollers by hand, so that it may not fold and be nipped in the fold. To compensate for the different thicknesses of the goods, the squeezing rollers are covered with loose, seamless felt sleeves.

§647. The goods after samming by a machine are ready for 'stuffing,' (Chapter XXVI), drying, or either of the other operations already above (§643) mentioned.

Drying.

§648. The drying of leather is an operation the importance of which is often lost sight of by the average manufacturer, and which consequently does not get the attention it requires; inferior finished leather is frequently the result of such inattention.

§649. To dry leather is to remove from it all excess of moisture. The removal of the redundance is effected by evaporation, and this is brought about by the employment of air, which itself becomes loaded with the vapour given off from the wet goods.

§650. When leather is dried under ordinary atmospheric conditions, as is still largely the case, especially with leather dried out after tanning, the drying often takes many days because of the slowness of the evaporation, particularly so in unfavourable weather. 'Weather drying,' as it is termed, is a slow process. With a climate so humid as the climate of this country, drying by mere exposure to the air is bound to be a precarious and unreliable procedure.

§651. According to Zachariasen,* 'the mean humidity of the atmospheric air for the 24 hours varies in Great Britain from about 89 per cent. (saturation being 100) in November, December and January, to about 74 per cent. in June, the average for the year being 82 per cent. At winter temperature of say 42° F., and humidity of 89 per cent., about 20,000 cubic feet of air would be required to vapourise one pound of water. In summer, with a temperature of say 82° F., and humidity of 75 per cent., about 2,400 cubic feet of air would be necessary, assuming that air on leaving the drying surfaces is completely saturated, for vapourising one pound of water. This will, however, not be the case in actual practice, and the volumes of air required for vapourising one pound of water would, consequently, always be greater than those given in the examples.'

* Journal of the Society of Dyers and Colourists, Jan., 1906.

§652. It will be understood from the above that whatever the temperature of the air may be, only a certain quantity of moisture, varying with the emperature, can be absorbed by it before saturation point is reached; and when that point is reached, there can be no further evaporation of the water from the leather that is being 'dried'; that word becomes in fact a mere figure of speech.

§653. The amount of water that can be taken up by a given volume of air, and consequently its drying power increases rapidly with a rise of temperature of the air, as is shown by the following table, (see also Appendix D.)

Table showing the carrying capacity of air at various temperatures:

Temperature—° Centigrade	10°	15°	20°	25°	30°	35°
,, ° Fahrenheit	50°	59°	68°	77°	86°	95°
Moisture in ounces per 1,000 cubic feet of air ...	9·2	12·7	17·1	22·7	30·0	39·1

§654. From this rapid increase of the absorbing power of air as it rises in temperature it necessarily follows, that a minimum volume of air must be heated the very highest possible to bring about the evaporation of a large quantity of water from the material that is being dried. There is however in the case of leather, as will be mentioned later, a limit of permissible temperature, a limit which if exceeded causes damage to the goods that are in course of treatment.

§655. As then the temperature of the air by which the drying of the leather is being effected may not be inordinately raised, and as at the allowable temperature only a definite amount of water can be absorbed by the air, it follows that in order to dry the leather rapidly the air must be frequently changed, the moisture-laden air being got rid of, and a fresh supply of heated air taking its place. The more frequently this change of air is made the

more rapid will be the drying of the leather; the getting rid of the moisture-charged air and the introduction of a further supply of heated air should indeed be continuously going on as the drying of the goods proceeds.

§656. A most important factor, when the drying of leather is to be effected is the hygrometric condition of the air; that is, the amount of moisture it then already contains when the drying of the leather is begun. From a practical standpoint this is of more consequence than the temperature of the air, especially in the case of the drying of wet goods after tanning or preparation. For it is evident that the heating of the air has first of all to dry up the existing humidity in it, before it can be serviceable at all in the direction of evaporating water from the leather goods. Generally speaking, the slower the drying of the leather, the better in the end will be its quality and colour. If artificial heating of the air is resorted to when the air is comparatively free from moisture, the grain of the finished leather is usually dark in colour and brittle. Particularly is this so if the artificial heating is in the early stages of the drying. The darkness of colour and brittleness are brought about in that the leather surface under such circumstances is dried too rapidly, and the drying of the internal leather does not co-ordinately keep pace with the surface drying. The quicker drying of the surface draws to the surface all excess of tanning matter in the leather, which excess dries as it were in mass, hard and solid.

§657. 'Weather drying,' as mentioned above (§650) is a very slow process under English climatic conditions, and except in the case of goods to be dried out of tan, it is seldom resorted to by present-day manufacturers. Even when the method is adopted, it is usual to warm up the air of the drying-room, for the completion of the drying, by means of the hot-water or steam pipes with which the drying-room is fitted.

§658. Air at a given temperature can only absorb a certain quantity of water. When therefore the air of the drying-room has taken its fill, so to speak, of the water evaporated from the

goods under treatment, it will do no more drying. Hence it is necessary that the air of the drying-room should be renewed, and this renewal can only be brought about by a thorough system of ventilation of the room. The ventilation may be effected (1) by means of a fan; (2) by ventilators near the floor of the drying-room, with provision for escape of the air in or near the roof of the room; or (3) by openings (louvre boards) on each side of the room which will allow of a free current of air to pass through the room.

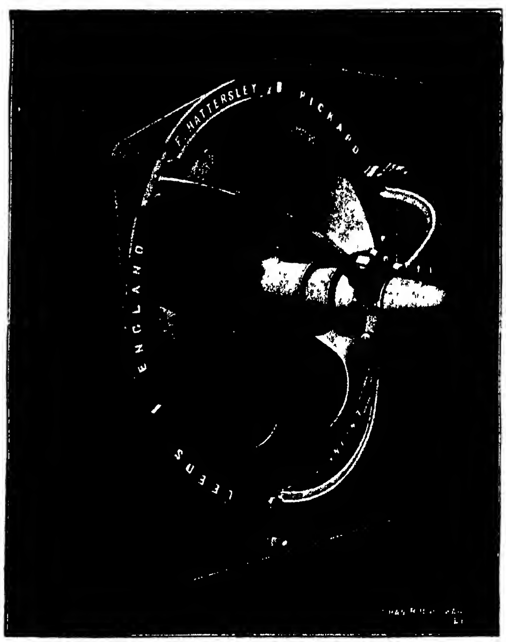


Fig. 113.

§659. The circulation of the air in the drying-room and the ventilation of the room, are now most generally effected by means of a fan (Figs. 113, 114), and this method is undoubtedly the best and quickest. The arrangement of a particular room to be used

as a drying-room requires considerable thought and care. The old form of drying loft with louvre-boards at the sides of the room, and steam pipes running along the floor in the centre of the room, is perhaps one of the very worst forms of room for the drying of partially dressed leathers, although it is a useful form when drying goods out of tan, especially so when weather conditions are suitable. The danger in the form of drying-room referred to, of local over-heating, that is to say of the over-heating of the leather hanging immediately above the pipes is a real one; particularly real in damp muggy weather, when it is customary and necessary to close the louvres and considerably raise the temperature of the air of the room, in order to get the leather dry.

§660. The general principle of all up-to-date installations for fan-drying is to circulate by means of the fan a plentiful supply of warm air through the drying-room, the air having been previously heated by passing through a coil of steam pipes. The drying of leather is better done always by a large quantity of air moderately warmed than by a small quantity highly heated, (§§654, 656). And this plan is further the more economical of the two. For the cost of moving the air by a fan is less than the cost of maintaining a comparatively high temperature by steam or hot-water pipes. Fig. 113 is an illustration of a large fan, and Fig. 115 is a fan shown in section.

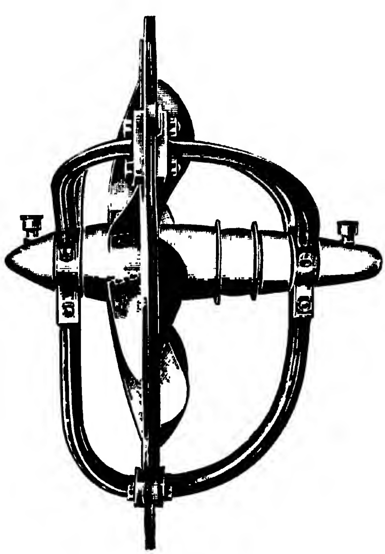


Fig. 114.

§661. The system of drying leather by fan is much abused, and indeed often found quite ineffective. Having placed a fan at one end of a drying loft possessing open louvres, it has often been held that nothing more was needed to be done. Such a fitting-up however is to be condemned as little better than useless, for the effect under such conditions of the movement of the fan is purely local, the fan sucking-in the air through the louvres nearest to it. In order to secure the full benefit of the air movement brought about by the rotation of the fan, it is necessary that the sides of the room should be quite closed, and that the only communication between the room and the outer air should be at the end of the room farthest away from the fan (Figs. 116, 117). Louvres are only useful for weather drying. A disadvantage attaching to the system of having a fan working at one end of the drying-shed as explained, is that the movement of the air is principally in the path of least resistance, and there is consequently a greater current of air down the middle of the room, at right angles to the plane of revolution of the fan, than there is nearer the walls, where the air is comparatively stagnant; and this tends to bring about irregular drying, as the rapidity of the drying depends entirely on the nearness of the goods to the direct line of the strong current of air. Instead of having one large fan it is in every way preferable to have two or three small ones; the drying of the goods is then much more equable.

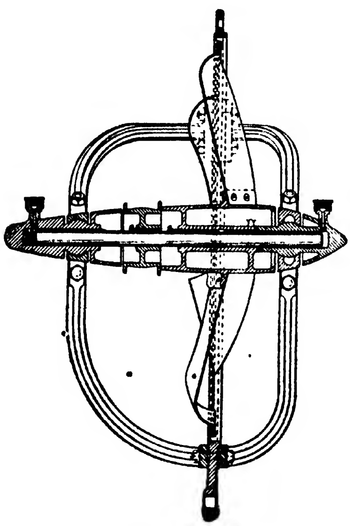


Fig. 115.

§662. Figs. 116, 117, 118, show a simple arrangement for a drying-room arranged to dry leather. The room is divided

longitudinally by a partition, and the fan draws air down one side of the room, and circulates it back again down the other

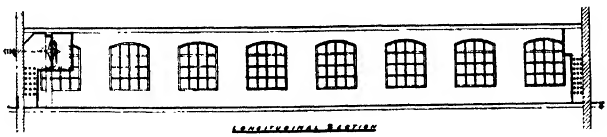


Fig. 116.

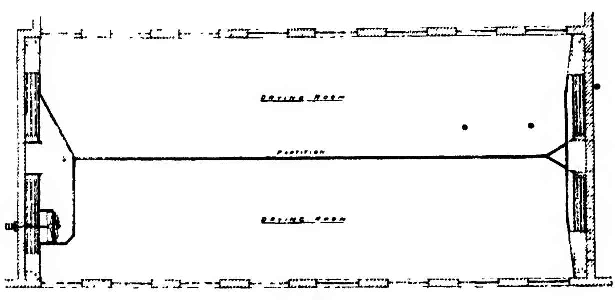


Fig. 117.

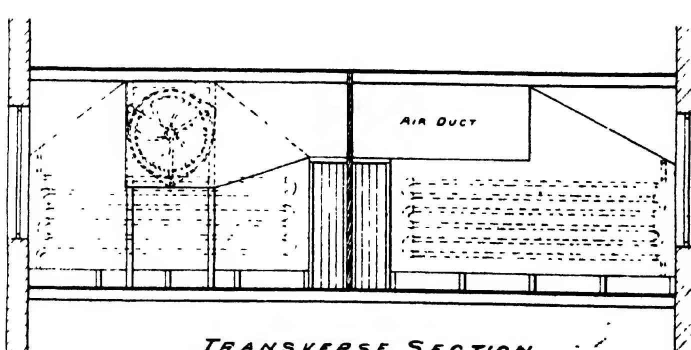


Fig 118.

side of it, the air being heated in its passage by coils of steam

pipes. Openings to the outer air are provided at each end of the room, and are fitted with air valves which can be opened or closed as desired.

§663. The circulation of the air of a drying-room by means of fans has been referred to, and screw fans can be used either to suck in air through them, or to set up a blast away from them; they are generally much more effective however for the former purpose than for the latter. When the blowing-in of air is intended, as for example, when air is to be conducted into the drying-room through galvanized pipes (air ducts) as described below, (§664), a fan specially designed for blowing should be employed.

§664. A fan six feet in diameter, running at full speed, at say 400 revolutions per minute, will move about 80,000 cubic feet of air per minute, and it will require about 6 horse-power to drive it. But as already stated a number of small fans are generally preferable to one large fan. A three-foot diameter fan running 500 revolutions per minute, will move about 12,000 cubic feet of air per minute, and a fan of this diameter requires only $1\frac{1}{4}$ horse power, to drive it. But on the other hand the larger fan, run at less speed, is more economical than the smaller fan run at a very high speed. The number of revolutions per minute at which any particular fan should be run depends on the diameter of the fan and the circulation required. For a fan of three-foot diameter an average speed would be about 450 revolutions

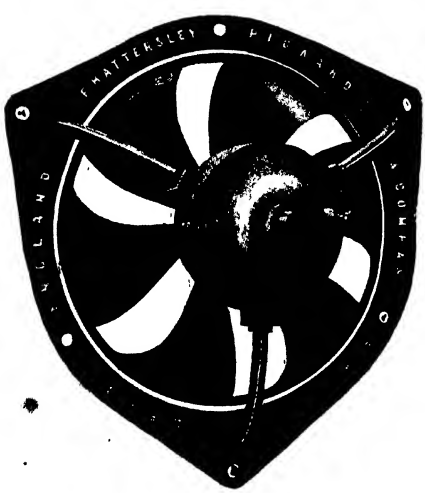


Fig. 119.

per minute; and for a fan of six-foot diameter an average speed

of 300 to 400 revolutions per minute. The running of fans by means of electric power operating in the drying room itself is a procedure generally to be recommended, as the running of such a fan at night-time is possible at but small cost for power. Fig. 119 is an illustration of an electric fan.

§664. A distinct form of the method of drying leather goods by means of hot air circulated by fans is that known as the blast system introduced by the Sturtevant Fan Company. There is here a fan blower (Fig. 109) constructed of steel plate, with its shaft directly connected to that of a steam engine or other motive power, so that it may be run day or night, while the line shafting is not in operation, and of two steel pipe heaters These are usually made up on cast iron bases into which are screwed one inch steel pipes, with cross connecting pipes above Through these pipes the steam circulates, and from a group o sections the water of condensation is readily trapped. Either live or exhaust steam may be used in the heater. The exhaust of the fan engine is always utilized in this way, thereby reducing to practically nothing the cost of driving the fan, which may b operated at any speed to meet any desired conditions. Th variety in temperatures required in various rooms has led to a special design of apparatus, particularly applicable to the drying o fancy leather, which is so arranged that either warm or cool ai or a mixture of the two, at any desired temperature, may b delivered at any given floor. The two heaters previousl mentioned are then arranged in two groups. The air with whic the first comes in contact, is placed at the inlet of the fan an merely serves to take the chill off the air, so that its temperatur when discharged by the fan may never be less than 60 degrees The main heater is so placed in conjunction with the fan, that ai is either forced through it or by-passed above it. Under the firs condition the air passes to the building at its maximum tempera ture. Under the second it receives no heat in addition to tha imparted by the tempering coil.

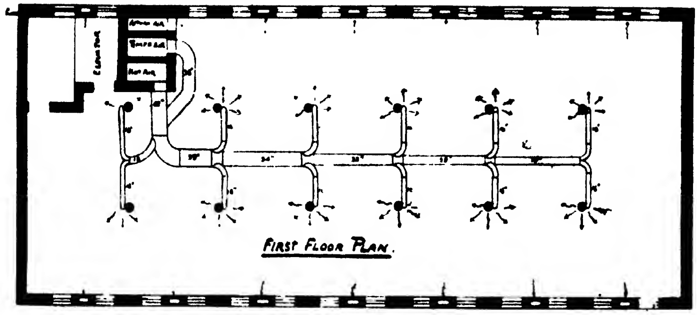


Fig. 120.

§665. The general arrangement of a leather-drying plant is illustrated in Figs. 120, 121 showing first and second floor plans, and sectional elevation of Pfister & Voegel's harness-leather drying plant at Milwaukee, U.S.A., installed by the B. F. Sturtevant Company. The building measures about 130 by 300 feet. The apparatus is located in the basement, adjacent to the bank of three vertical brick flues. Into one of these hot air is forced, to the second tempered air is delivered, while the third serves as a return flue through which air which is still warm, but not over moist, is returned from the rooms above. This condition obtains in rooms in which the drying process is nearly completed. Along the ceiling of each floor extends a system of hot air piping with drop pipes at each of the columns. The air is discharged close down to the floor and there spreads out in even volume, whence it rises in the spaces between the hides, absorbing at the same time large quantities of moisture. Thorough distribution is thus secured, and discolouration which would result from blowing directly on to the leather is avoided. Outlet registers shown in the Fig. 121 as located in wall flues, are so arranged that air may escape through them from the rooms, and be discharged above the roof. In such rooms as contain but little moisture, these vent registers may be practically closed and the air drawn back by the suction of the fan through the vertical return duct, whence it will pass through the tempering coil in conjunction with fresh air from out

of doors, and complete the circuit by being drawn through the fan blower and forced through the heater and thence through the flues. On each floor a by-pass connection is arranged from the tempered air flue to the hot air pipe after it leaves the hot air flue. By an arrangement of dampers it is possible to make a mixture of the hot and tempered air at any desired temperature, distribute it through the openings to the room, and by further manipulation of dampers to absolutely control the amount of air, and consequently the rate of air change and of drying within the individual room.

§666. The general features of such a distributing system are shown in the sectional drawing, Figs. 122 and 123. The complete

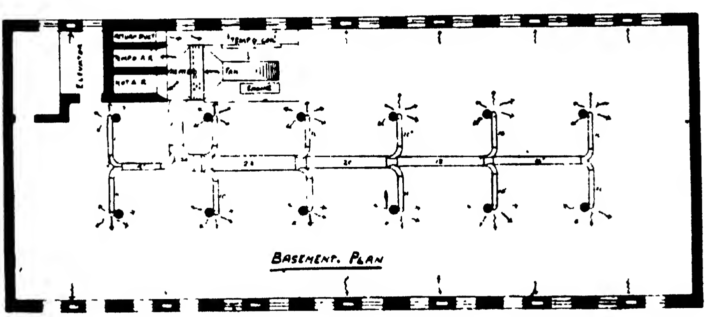


Fig. 121.

arrangement described makes possible the maintenance of radically different conditions on the various floors, each suited to the exact requirements of the material contained therein.

§667. It will be noticed that the system of central heating is adopted, the air being heated at one point only and outside the drying room. There must doubtless in this way be a considerable amount of heat lost by radiation, and in the absorption of heat by the sides of the air ducts during the passage of the air and the points of final discharge into a drying-room; and particularly must

this be the case when a large number of rooms are to be heated at some distance from the blower. The conveying of the warmed

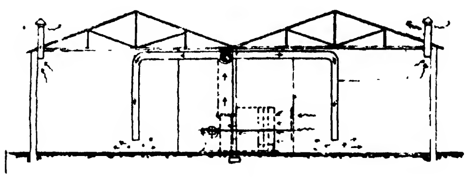


Fig. 122.

air to the various parts of the drying-rooms, as shown in the Figs. appeals to the author as being a distinct advance in the method of heating these rooms. The discharge of the hot air on to the floors of the rooms, that it may spread along the floors, and be gradually rising and passing between the skins to be

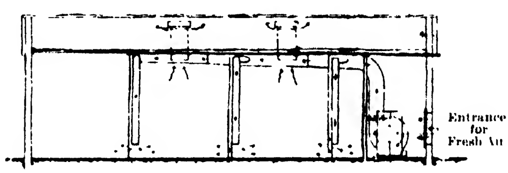


Fig. 123.

dried, appears to possess advantages over the method of drying by drawing a current of air through a drying-room by means of a fan placed at one end of the room.

§668. Figs. 124 and 126 show a somewhat different form of drying installation on the blast system, designed by Messrs. Hattersley Pickard, Leeds. The air is in this case heated by blowing it through coils of steam pipes; the heated air after being conveyed to the drying room is distributed by ducts which are placed round the walls of the building and resting on the floor as shown in the Transverse Section (Fig. 126).

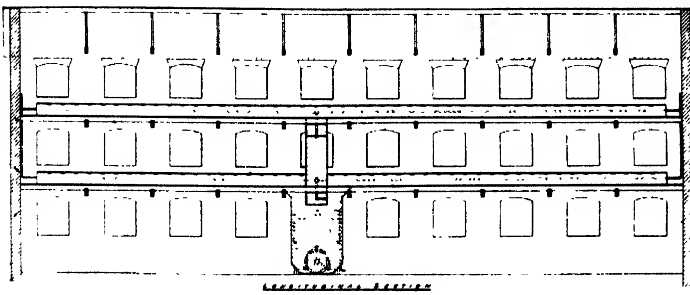


Fig. 124.

§669. The Fig. 125 shows a 'combined fan and sectional air-heater,' in which there is a large amount of heating surface contained in a small space. The apparatus is constructed of a number of compartments fitted with steel tubes, which are connected

Fig. 125.

together and enclosed in a steel plate casing to one end of which a fan is fixed for forcing or drawing air through the heater portion.

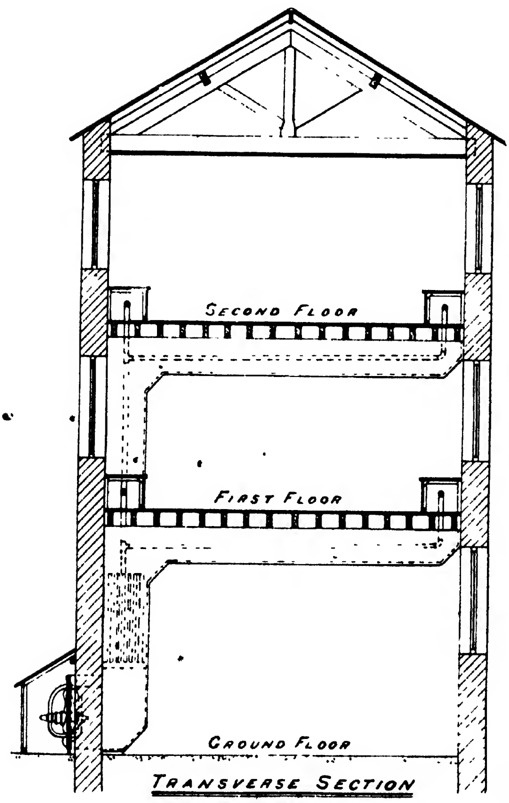


Fig. 126.

A large amount of air can be forced through ducts for considerable distances to places where it may be required. The plan of heating the air in the drying-room itself has the advantage of allowing a good deal of drying being done during the night without its being necessary to keep the fan running.

§670. The Fig. 127 shews an illustration of the Bourne hot air system of drying. As will be seen from the illustration the air is heated by being drawn through a heater, and the heated air is conveyed through air ducts to the various drying lofts. The air ducts in this form of plant are placed round the walls of the building and near the floor.

§671. A recent invention (Patent 310, 1906), by Edward Pim, of Liverpool, constitutes a new departure in the construction of drying rooms. A hermetically sealed chamber internally fitted with both hot and cold water pipes is employed. The leather to be dried is placed in the chamber which is then closed. The moisture absorbed by the air from

the wet goods is condensed on the outside of the cold water pipes, from which it is allowed to fall into drainage pipes and conveyed to the outside of the chamber. The evaporation of the moisture from the leather and the condensation of this by the cold water pipes is practically continuous until the leather has been entirely freed from moisture. The temperature of the drying chamber can be carefully regulated by means of both the hot and cold water fittings. This method, in the opinion of the author, appears to be a distinct advance on present day methods especially for use in drying goods out of tan, but of doubtful utility when dyed leathers are to be treated.

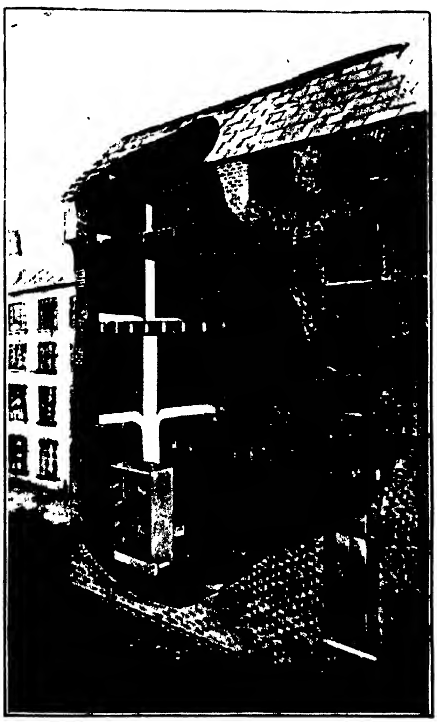
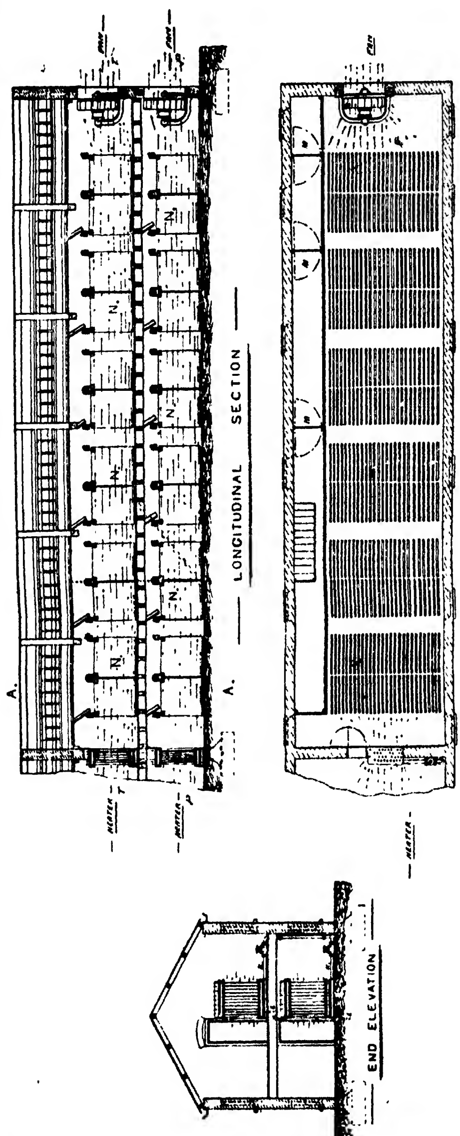


Fig. 127.

§672. THE WET AND DRY BULB THERMOMETER.—With the aid of this simple instrument, which ascertains the quantity of moisture present in the air, it is possible to exercise a considerable control over the leather-drying operation.

§673. This thermometer, Fig. 128, comprises a pair of thermometers, which are fixed to a wooden backing. Attached to the bulb of one of the thermometers and surrounding it is a piece of



Drying Sheds. (Seagrave-Bevington System.)

cotton or lamp wick, to which there is a free end. The free end dips into a small vessel, shown in the Fig., which contains water, and by capillary attraction the clothed bulb is thus always kept wet. The water evaporating from this bulb causes its temperature to be lowered, and the difference of the readings of the two thermometers is of course proportional to the amount of evaporation that is taking place. That is to say, the variation in the readings will be greatest when the air is driest, less when the air is humid, and least when the air is at its saturation point with moisture and there is no evaporation from the wet bulb.

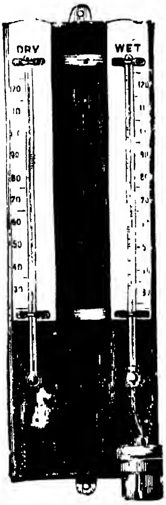


Fig. 128.

§674. The amount of aqueous vapour present in the air can be approximately calculated, in ounces per 1,000 cubic feet, by multiplying the difference between the readings of the two thermometers by 0·64 for a Centigrade scale, or by 0·35 for a Fahrenheit scale, and deducting the product from the total capacity for moisture corresponding to the temperature shown by the wet bulb, as given in the table (§653). The result of the subtraction will be in ounces the actual moisture present in the air per 1,000 cubic feet. For all practical purposes it is only necessary to note that variation of reading between the two thermometers which gives the best drying result for the particular leather under treatment, and to so arrange the heat supply that the two thermometers shall stand always with that same variation between their respective readings. The variation between the readings of the two thermometers which generally gives the best results is, when drying tanned leather 5 degrees F, and dyed leather 10 degrees F.

§675. In the matter of coloured leather it is essential that the drying should be moderately quick, as otherwise the dye will by capillarity be drawn away from the surface of the leather, and the leather when dry will be lacking in fulness of shade and have a hungry appearance. In the case of thin goods, such as skivers,

Persian sheep, basils, etc., from four to six hours should be an ample time for the drying with a properly equipped and efficient drying-room. Calf and heavy goods such as kip shoulders, bellies, etc., will usually require from eight to ten hours to dry, and hides from twelve to fourteen hours.

§676. Goods before drying are usually oiled over on the grain side. The purpose of the oiling is to obtain greater uniformity in the finished colour of the leather in the case of dyed goods. When goods are being dried out of tan, or during the preparatory processes of dressing, for example after setting, the object of the oiling is to ensure the dried leather being of a good colour. The thin film of oil on the grain surface of the leather makes a more or less air-proof seal, so that the drying proceeds mostly from the flesh side of the leather, and excess of tan is drawn by capillarity from the grain side of the goods.

§677. In the case of dyed goods it is customary to either hang the skins up by the hind shanks to dry, or else to strain them on boards or frames and dry them thus strained. The goods that usually require straining are the light and thin goods, which by reason of their lightness and thinness get an irregular stretch, or on which the operation of setting cannot be carried out because of the cost of the extra labour, or because of the tenderness of the goods. As for example, skivers, Persian sheep, etc. Irregular stretch has to be got rid of, and the straining effects this. Straining is mostly done by boys, who carefully, in as flat a condition as possible, all irregular stretch being pulled out, nail the skins to the boards or frames (Fig. 129). A skin that has been dried out while strained, particularly if the drying has been done rapidly, has very little stretch when dry and finished. Such a skin does not possess the plump, mellow feel that there is in goods which have been hung up and

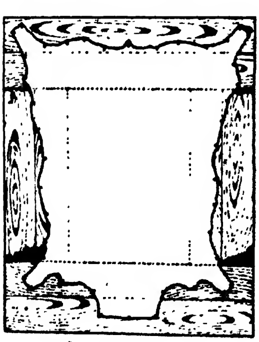


Fig. 129.

allowed to become dry. And the reason is that in the skin which has been allowed to become dry, the fibres of the leather have dried in their as it were felted or woven together condition, whilst in the strained skin, the straining has pulled the fibres all in the one direction of parallel to the straining-board or straining-frame, and in the drying the fibres have become fixed in that position.

§678. In the case of chrome-tanned leathers which shrink considerably if allowed to dry unstrained, straining is often necessary in order to regain the area of the leather. A good plan to follow with such leathers, especially glacé kids or glacé sheep, is to dry the goods hung over a pole (§681), to damp them for staking (see Chapters XIV & XXII), to stake them, and then to strain in order to get as much surface as possible. If this method is followed the plump feeling of the leather is retained, as the fibres dry and fix in their intermixed condition first, before the straining; and the goods are invariably quite soft when taken off the boards dry.

§679. An ingenious method of straining without the use of nails is shown in Fig. 130. In this case the goods are attached to a frame around the sides of which a small-mesh wire gauze is fixed. Toggles take hold of the edges of the skins, and to the toggles small hooks are attached by cords. A strain is put upon the leather wherever a hook is attached and the strained hook is secured into the mesh of the wire gauze. The Fig. 130 shows this.

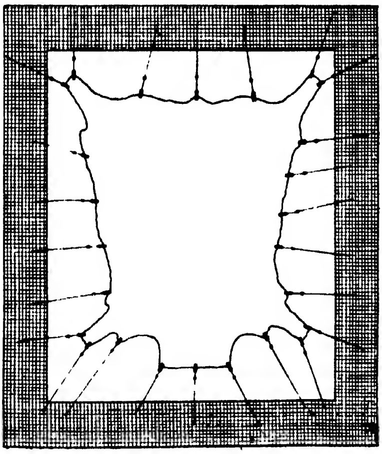


Fig. 130.

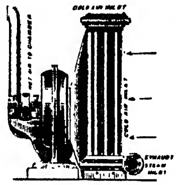
§680. The usual method of suspension of goods which are hung up to dry is by the hind shanks from hooks or nails fixed in wooden beams running across the ceiling of the drying room, (see Fig. 127). Calf skins and heavy goods are not as a rule hung directly upon the hooks or nails, but have loops of twine or cord attached to the hind shanks of the skins, and are suspended from the hooks or nails by means of these loops. For heavy goods this is a convenient method of suspension. When the goods are strained on frames (§677) and dried so strained, a loop of string is attached to each corner of the top rail of a frame and the suspension is by the loops. A drying room can in this way be utilised for drying both strained and unstrained goods, without any interference with the structural arrangement of the room. When the skins are strained on solid boards for drying these are usually a permanent fixture in the drying room (see page 248).

§681. Chrome goat and sheep skins, instead of being suspended by the hind shanks, are most conveniently placed to dry by being simply hung over light wooden poles positioned horizontally.

§682. In hanging goods to dry, it is important that the space left between the goods should be sufficient to allow for a free circulation of air between the skins. The skins should never be hung in contact with each other. In the case of goods that touch, not only does such adhesion add to the time required for drying, but the parts that touch of the skins will invariably dry of a different colour from the other portions.

§683. Drying in the Stove.—The stove is a small drying-room used in drying goods during the finishing operation, such as after wet-graining in the case of moroccos, seasoning, flaming, topping, etc.; and after setting in the case of calf, hides, etc. In the case of stove-drying, but little ventilation is required, for the reason that when the goods are placed in the stove the wetness is merely superficial. What is usually required in stove-drying is air of high temperature, and dry, with little ventilation, quick drying being the essential matter. The ventilation necessary can be obtained by one or two openings near the top of the chamber, and slightly larger openings near the bottom. Even

this provision for ventilation is not an absolute necessity, as it generally happens that the door of the stove is being frequently opened by the workmen passing in and out of the room with goods, and this gives a sufficient ventilation. The heat is best supplied by one or two coils of steam pipes placed near the centre of the room, or by pipes running round the room near by the walls, a few feet from the ground.



Combined Fan and Air Heater.

CHAPTER XIV.

Staking and Perching.

§684. Staking.—It is usually only alum-dressed and chrome-tanned leathers that go through the operation of 'staking.' The 'stake' is a semi-circular steel blade with blunt edge fixed vertically in a strong wooden support which is bedded into the ground or firmly fixed into a heavy wooden block. Figs. 132 and 133 are drawings of a stake, showing front and side elevation. The leather, previously damped to a suitable condition, is taken hold of by both hands, flesh side downwards, and the portion between the hands is worked with force backwards and forwards over the edge of the knife. The Fig. 131 illustrates the operation. Thus, portion by portion, going over the whole skin, and stretching it in every direction to its fullest extent, all rigidity and harshness is taken out of the leather, and it acquires considerable softness and pliancy. When a skin is particularly hard, the work-

Fig. 131.

To face page 255.

Staking Machines.

man will make use of his knee as well as his hands. Having fast hold of a portion of the leather with both hands, with his left hand at the back of the stake and bending more or less over the stake, he pushes his knee into the leather above his right hand, and with the exertion of power by both hand and knee pulls it over the top of the blade. When staking is done by hand alone, the stake is about 3 feet high; it is somewhat lower when both hand and knee are used.

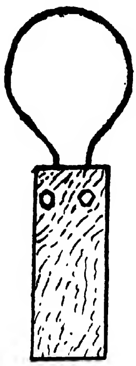


Fig. 132.

§685. Goods are prepared for staking by being packed in damp sawdust. Two skins are taken and placed together grain side to grain side. The pair of skins is then laid flat on the floor of the 'dusting room,' and a thin layer of the damped sawdust is 'dusted' over them. A second pair of skins, similarly put grain to grain, is laid on the top of the first pair, and these are in like manner dusted with the damp sawdust. The whole pile of skins is then treated, and the pack is then covered up and left so that the moisture may spread equally throughout, which it does in from 12 to 48 hours according to the state of the sawdust. It is better to use sawdust that is but slightly damp and to give time for the moisture to soak through the pile than to use a wet sawdust and trust to rapid soaking. In the latter case the dampness of the goods is sure to be unequal.

Fig. 133.

§686. The staking of the goods stretches them more or less out of shape; for pulling the skins into shape they are usually laid one by one, with the ridge of the skin at top, over a kind of hurdle or 'horse,' shown in the Fig. 134a, and in end elevation in Fig. 134b. The workman, standing astride of the hurdle, pulls the skin first of all by the two fore-shanks, then by the middle

of the belly, and lastly by the hind-shanks, thus restoring it to its original even condition, the condition in which it was before being mis-shaped by the staking.

§687. Machine Staking.—The staking machine is of comparatively recent origin. One of the first machines that resembles in construction the machine that is in present day use was patented in this country in 1885 by Alphonse Jesson. The machine has two strong hinged jaws, the upper one of which carries a rubber roller, the lower carries a steel stake or stretcher, and to these two jaws, as a unity, a reciprocating motion is given by wheel and crank. The leather to be staked passes over a rubber bolster at the front end of the machine. and between the two jaws.

Fig. 134a.

The operator holds the leather by leaning his body against that portion of it that is between himself and the bolster. The machine being in motion, the jaws close upon the leather, and take their stroke away from the operator, thus stretching that part of the leather that comes between roller and stake during

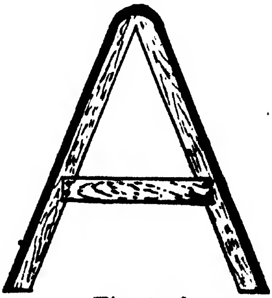


Fig. 134b.

Fig. 135.—Slocomb Staking Machine.

the stroke. The jaws now open and take their return stroke towards the operator, and during the return stroke the operator shifts the leather as he desires. Since the first introduction of the machine many improvements have been made upon it.

§688. Another type of staking machine is the Baker Machine patented in 1888. The leather is laid upon the machine-table which has a clamp at its front end. Grooved into the table longitudinally is a reciprocating slide, which has a transverse slot in it positioned towards the front end of the table. The staking tool, which also reciprocates, is above the table and has a friction-blade near to it. The two reciprocations correspond. At the close of the movement of the slide and staking tool towards the front of the table the clamp grips the leather firmly and the staking tool descends and presses the leather into the slot in the slide, at the same time that both tool and slide move away from the front of the table. The friction-blade precedes the staking tool and prevents the leather from wrinkling. A portion of the leather as wide as the staking tool is long, and as long as the stroke of the tool, is thus stretched upon the tool. At the start of the return stroke of the tool and slide the clamp opens automatically and the operator shifts the skin ready for the next stroke.

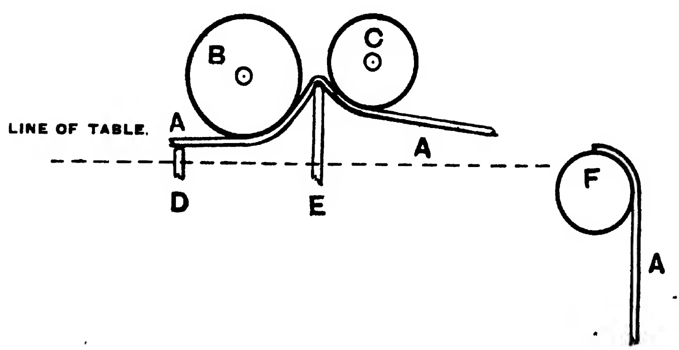


Fig. 136.

§689. The staking machine that is now in favour in this country is the Craig and Slocomb Machine, patented in 1897. It

is represented in Figs. 135, 136. To a head which works in slides in the machine framework, a reciprocating movement is given by a crank and connecting rod. The jaws of the machine are pivoted at their rear ends in the sliding head; at their front ends they carry the tools by which the leather is manipulated. The manipulation will be understood from the diagram Fig. 136. B and C are rollers, which are carried in bearings rigidly fixed to the top jaw. D and E are steel blades, attached rigidly to the lower jaw. The blade E is situate between the rollers B and C. F is a breast-beam covered with indiarubber fixed at the front end of the table of the machine. A, A, A, represent the hide or skin that is being staked. This is passed over the breast-beam or roller F and held there stationary by the body of the operator pressed against it. The jaws of the machine when at the extreme forward end of their stroke, towards F that is, close by cam action more or less together, according to the thickness of the goods; and with the skin thus gripped between the rollers B and C in the top jaw and the blades D and E in the lower jaw, the jaws take their stroke backwards away from F, the portion of the skin that comes between the rollers and the blades during that movement being thus scraped or staked. The blade D prevents any wrinkling up of the leather. The hold of the jaws on the leather is released at the extreme end of the backward stroke of the jaws, which now move forwards. During the forward movement the operator shifts the hide or skin as desired ; and so on till every portion has been treated or staked.

§690. In all staking machines there must necessarily be provision made for various adjustments. These need not be detailed. One of the adjustments of the Slocomb Machine is however of its own kind and therefore noticed. The spokes at the extreme right of the illustration Fig. 135 are worked by the knee of the operator, and by such action on his part the position of the lower jaw of the machine is regulated, and consequently the pressure of the staking knives upon the skin or hide.

§691. A number of staking machines at work are shown in the plate facing page 255.

Fig. 137.

§692. PERCHING.—This is a hand operation (see Fig. 137.) The operation of staking, as will be evident from the description of it above, is of a somewhat violent character, and skins which are intrinsically soft in their nature and will not bear rude treatment, are not staked but 'perched.' The scraping or abrading of the leather in staking is carried out by working the leather over the tool, the tool being stationary; in 'perching,' it is the leather that is stationary and the scraping is brought about by working the tool over the leather, the tool being at the same time pressed into the leather so as to add to its softness and make it more pliant. With naturally soft goods perching is generally preferred to staking, especially so if heavy goods, such as calf, kips, etc., are to be softened; moreover, the goods are not pulled out of shape and the flanks and thin loose portions of the skins are not 'broken up.'

§693. 'Perches' are of several kinds. One sort of perch is shown in the illustration. To describe the various perches in their details is not worth while; the essential of all of them is that they shall be able to take a firm grip of the skin that is to be treated. The perch shown in Fig. 137, consists of a bar horizontally tenoned, or otherwise strongly fixed, in two uprights. The skins to be perched, one or several, are thrown over this bar flesh side outwards, and a second bar, above the fixed bar, is brought down upon the skins. One end of the upper bar holds in a groove in one of the uprights, the other end is received in a groove in the opposite upright and firmly wedged there, (see the Fig.) and the goods are thus securely clamped between the two bars.

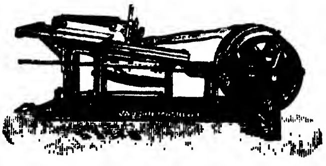
§694. The tool made use of, the perching-knife, or 'moon-knife' as it is termed, is a circular knife from 8 to 10 inches in diameter, shallowly concave, and with a central opening of from 4 to 5 inches diameter. The edge of the knife is not particularly sharp. Passing his hand, from the concave side of the knife, partly through its central opening, the workman grasps the knife at the handle which is fixed in the central opening, protecting his arm by a covering, where, (see the Fig.), but for some protection, he might be injured by the edge nearest him of the knife. Holding the knife in this way, with its convexity towards the leather, he takes the bottom edge of the leather by his left hand, and making the skin taut, he works the knife from above downwards, over the flesh side of the skin. The convexity of the knife being towards the leather and its edge turned over towards the concavity, the knife cannot penetrate too deeply. Still the operation requires much skill, and like the various operations of hand-shaving, (§§84-88), it is an 'expert' operation. The height of the clamping-bars of the perch is usually 5 feet, or thereabouts.

§695. Instead of holding the bottom edge of the goods by his left hand, the workman sometimes attaches a 'toggle' (§679) or jointed wooden clip to a cord and the free end of the cord to his girdle, and places the edge of the skin in the jaws of the clip or toggle. Thus putting the necessary strain on the leather he has

both hands free for the knife, and can use the knife with more strength and put more pressure on the leather he is perching. Or instead of attaching the free end of the cord to his girdle, the worker will sometimes make a large loop of it and pass the loop over his body, raising the loop or lowering it as best suits the skin under treatment. Or, making a smaller loop, (the German method), he will attach it to his knee, and in this way keep up the requisite pull upon the leather for the stroke of the knife to be effective.

§696. When the goods to be operated upon are so hard as to require a more vigorous treatment than is obtainable with the ordinary perching knife, the latter is substituted by the 'crutch stake.' The crutch stake is made by fixing the ordinary perching knife or moon knife into a short wooden shaft provided at the opposite end with a wooden cross handle. Placing the cross handle under his arm and taking hold near the knife with his right hand the workman works over the flesh side of the skin in the perch (§694). The extra pressure which the operator is enabled to bring to bear on the knife, by pressing against the cross handle, assists considerably in the softening of the leather.

§697. During the operation of perching it is necessary in the case of large skins to change the position of the goods in the perch four times so as to work over the whole of the skin, working first from butt to neck; secondly from neck to butt; thirdly from ridge to left hand belly, and finally from ridge to right hand belly.



CHAPTER XV.

Leather-Finishing Materials.

§699. Albumen.—The most important of the materials used in leather finishing is perhaps albumen, this being the all-essential ingredient in a 'seasoning' mixture for application to leather before it is pressure-glazed. Albumen exists in the white of egg and in the 'serum' of blood. In admixture with other ingredients, blood is universally employed as a 'season' when black leathers are to be glazed. Both blood-albumen and egg-albumen are on the market; the latter in solid form only; the former is sometimes sold in liquid as well as in solid form.

§700. Blood-Albumen.—When blood is withdrawn from the body of an animal, it 'clots' or 'coagulates.' If allowed to stand, it divides into two portions, a firm red *clot* floating in a straw-coloured fluid,—the *blood-serum*. It is the blood-serum that contains the albumen. The process gone through is this. Ordinary bullocks' blood is run into shallow vessels and allowed to clot. The clotted blood is then transferred to trays which are placed on slightly inclined racks or shelves. The trays are fitted with false perforated bottoms, and the blood remains in them until the above separation into two portions has come about. The time required for this separation is usually from 18 to 36 hours, according to the temperature. When the separation is complete the serum is drained off from the clots into shallow trays, which are placed in racks in a room the temperature of which is kept at about 110°F to 120° F. The trays remain in this drying-room until the whole of the water contained in the serum, some 90 per cent. of it, has evaporated, and there is then left in the trays, each of them, a thin sheet of blood albumen. The blood submitted to

this process should always be as fresh as possible; this is exceedingly important when the finest qualities of blood-albumen are being prepared.

§701. In the making of liquid blood-albumen the serum is evaporated until it is in a pasty condition, not until it is dry; and a preservative agent is added to the paste so that it may not *putrify on long keeping. The most common preservative is* 'mirbane' (nitro-benzine): *distinguishable by the sweet almond-like smell that it possesses.*

§702. Blood-albumen is always more or less coloured by foreign matters derived from the blood itself, and also often contains traces of iron. Both colouring matter and iron are great disadvantages. When used in finishing such a sample tends to dull the shade of colour, and especially so when applied to light-coloured leathers; for which reason it is always advisable when employing blood-albumen for finishing purposes to choose a sample as light itself in colour as possible: the lighter coloured sample invariably containing much less iron than a dark coloured one.

§703. In some cases, such as in the finishing of blacks and dark-coloured leathers, it is preferable to use blood itself instead of blood-albumen. The organic matter present in blood does not contain any albumen; this is contained, as the finisher should ever remember, in the serum only. Although however the organic matter contains no albumen, it acts as a filling agent, filling up the grain of the leather, so that a better final finish is secured than if blood-albumen alone had been employed. As previously mentioned blood-albumen is to be had in liquid form and this plan is generally to be preferred to albumen sold in solid form, as it often happens owing to coagulation of the albumen during the manufacture (§700) that not more than 5 or 10 per cent. of the sample is soluble in water.

§704. When using blood itself in finishing the addition of a little mirbane (§701) is an advantage, especially in warm weather. A quarter of an ounce per three gallons of blood is sufficient to prevent for some weeks the decomposition of the blood.

§705. Another preparation of blood in the market is known as desiccated blood, or desiccated blood-albumen. This product, which is nearly black in colour, is simply blood that has been allowed to clot and then has been carefully evaporated to dryness. Many of the blood-albumens in commerce have been decolourised. The decolourisation is usually effected by adding small quantities of animal charcoal to the blood-serum before evaporation; this effects the removal of the colouring matter. After being thus treated with charcoal, the mixture is filtered, and the clear colourless albumen is evaporated as above described. It may be of interest to mention that 60 lbs. of blood will only produce about 1 lb. of blood-albumen.

§706. EGG-ALBUMEN.—Egg-albumen is made from the white of eggs, which is evaporated in shallow trays until the whole of the water has disappeared, much in the same way as the water is evaporated from blood-serum. The solid, light-yellowish residue is the egg-albumen.

§707. The temperature at which the evaporation is carried through is a matter of considerable importance. If the temperature is too high, the albumen coagulates and becomes insoluble. The temperature should not be greater than 120° F. The white of from 80 to 120 eggs is necessary in order to obtain 1 lb. of egg-albumen.

§708. Egg-albumen is usually employed in the finishing of light-coloured leathers. Unlike blood-albumen, it contains no colouring matter or traces of iron that is likely to have a detrimental or darkening effect upon the shade of colour of the leather.

§709. Albumen is a material that is exceedingly sensitive to coagulation and precipitation with metallic salts, and when a finish is being prepared, particular attention must be paid to the purpose of the finish. No metallic salt that precipitates albumen should be added to a seasoning mixture containing albumen.

§710. A caution has just above (§707) been given as to the coagulation of egg-albumen by heat. This caution applies also to blood-albumen. Albumen coagulates at about 130° F.; and on

this account the water used to dissolve either blood-albumen or egg-albumen should never be of higher temperature than blood heat, say 98° F.. It is often the case that in the preparation of the commercial albumens the evaporation has been carried out at too high a temperature and that the albumens have coagulated and been thus rendered insoluble; the consequence being that when they are wanted for use they will not dissolve. Many of the solid blood-albumens on the market do not yield to water more than 5 per cent. of their total weight.

§711. Carbolic acid also precipitates albumen, and if employed as a preservative agent either in the case of albumen or for blood, it should be only in exceedingly small quantities.

§712. The leather finisher, although he makes use of albumen in his working, is by no means always cognisant of what is taking place, and does not know that he is profiting by the properties of albumen that have been mentioned. The experienced leather finisher is well aware, in the finishing say of moroccos, that when the leather has been treated with a seasoning of albumen and milk, and dried at a fairly high temperature, the colour of the leather is much faster to rubbing than it was before being thus treated. From what has been said as to the properties of albumen it will be clear that two reasons may be adduced for this extra fastness of colour against rubbing; first, that the albumen to a certain extent fixes the dyestuff so that it is less loose in the leather, and secondly that the albumen is coagulated by the heat at which the leather is dried and thus gives a coating more or less insoluble on the grain surface of the leather.

§713. Albumen will dye in the same manner as animal fibres. This quality of albumen may often be taken advantage of when staining leather by first bottoming the leather with a weak solution of albumen and then drying it before applying the stain. The method is useful in two ways. It modifies the manner in which the dye strikes bad grain, and the bottom that is given furnishes an excellent medium to stain upon; for, to a greater or less extent the bottom prevents the dyestuff sinking into the leather, and the method is thus economical in dyestuff.

§714. In the finishing of moroccos the albumen used often becomes a mordant, although in using the albumen such purpose for it was not intended; the leather in the case of hard-grain goats being seasoned with albumen and milk, glazed and grained, and then topped or stained on the albumen.

Milk and Casein.

§715. Milk.—This material enters largely into the composition of leather seasonings, particularly for the seasoning of light leathers. Milk contains 3·4 per cent. of fat, 3·5 per cent. of casein and albumen, 4·8 per cent. milk sugar, and 0·6 per cent. inorganic matter, the rest being water (§604).

§716. The chief value of milk in a seasoning comes about from the finely divided state of the fat contained in it. This helps to lubricate the grain of the leather and to prevent any damage to it from friction during the process of glazing.

§717. The casein and albumen in the milk act similarly to the albumen of blood and of egg. It may be mentioned that casein can now be obtained commercially; it can moreover be easily prepared as follows:—

§718. To 1 gallon of new milk add 2½ oz. of ammonia, and after well shaking the mixture, set it aside for 24 hours. At the end of that time it will have separated into two liquid layers. The lower liquid should then be run off, and the casein may then be precipitated from it by a little warm acetic acid. The precipitate is filtered through cotton, and strongly pressed to expel moisture. A little sugar is then added and the mixture carefully dried and ground.

§719. Casein is only soluble in weak alkaline solutions; it is best dissolved by boiling in a weak solution of borax. It forms an excellent substitute for the more expensive albumen, and is now being largely employed in the finishing of fancy leathers.

Glue and Gelatine.

§720. Glue and Gelatine.—Glue is made from small pieces of hide and of flesh (fleshings) removed from the goods whilst they are in a limed state. The tanner keeps these small pieces until he has accumulated a considerable quantity; they are then sold to the glue manufacturer.

§721. Gelatine, of which glue is an impure form, is a product obtained from various animal tissues by dissolving the soluble portion. Its quality depends upon the care with which the material for its manufacture has been selected, and the cleanliness of manipulation. Gelatine of the best quality is made from the 'piths' or 'sluffs' (sloughs) taken from the inside of the horns of cattle. During its manufacture it is usually decolourised and clarified in order to obtain a gelatine as light in colour as possible.

§722. Glue and gelatine although perhaps not the most suitable materials for leather finishing are used to a considerable extent in the finishing of many classes of goods.

§723. As a bottom for staining, glue and gelatine are frequently used, though they do not answer quite so well for this purpose as other of the mucilages, yet they have their advantages in special cases. Gelatine is much favoured by stainers of East India kips for bottoming and for thickening up the dye solution.

§724. Gelatine or glue is also used as a finish upon black seal moroccos. The usual finish for this class of goods is a mixture of logwood liquor and iron liquor, thickened with a strong solution of glue. The leather thus treated has a bright appearance and a crisp feel.

§725. As one of the constituents of the finish used upon the grain side of curried leathers such as wax calf, wax kips, &c., glue is also largely used. In the finishing of coloured French calf gelatine may be serviceably employed where a bright firm finish devoid of greasiness is required.

§726. The chief objection to glue or gelatine as a finishing material is that it is brittle. That is to say, if, either in the form of a mucilage or thin solution, a slight excess is applied, the leather when dry is apt to crack or break.

§727. Gelatine is a very useful finish for hat leathers. For these leathers the objection just above mentioned of cracking or breaking is of less moment, as the leather is not subjected to any stretching.

§728. The best form in which to apply either glue or gelatine is as a thin, soup-like mucilage. It is impossible to give quantities, as these depend entirely upon the solidifying power of the particular glue or gelatine that is being used. Very often a 1 per cent. solution of a gelatine of fair quality makes a much stronger mucilage than a 7 or 8 per cent. solution of a common quality glue. That is to say that 1 lb. of gelatine is in many cases equal to 7 or 8 lbs. of glue, so that it always pays to buy a good quality gelatine rather than a common quality glue.

§729. As already mentioned gelatine or glue may be used upon leather as a bottom before staining. Though gelatine resists the dye somewhat more than linseed and other mucilaginous mixtures, it forms a very satisfactory covering for bad grain, for which purpose it may be advantageously used, and especially upon 'russet' and leather dressed in its natural colour.

§730. In staining leathers, or in topping and flaming dyed leathers, the addition of a little gelatine to the dye solution is an advantage; it prevents the dye sinking deeply into the leather, so that a deeper shade of colour is obtained with a less quantity of dye than must have been used but for the gelatine addition to the solution.

§731. Glue or gelatine, either of these materials, should be dissolved by first soaking in cold water until thoroughly swollen, when the swollen mass should be transferred preferably to a

jacketed pan, and carefully warmed until the dissolving is completed. In cases where a fairly strong solution is required the addition of a little acetic acid to the mucilage is an advantage, acetic acid reducing the setting power of the glue to such an extent, that if necessary, and sufficient acid is used, the solution can be kept in a liquid condition without losing any of its sticking or attaching powers. It is by the addition of acetic acid to a strong solution of glue that the liquid glues are made.

§732. Glue and gelatine on long boiling gradually lose their qualities and powers, and care must therefore always be taken to avoid long boiling. After glue or gelatine has been allowed to set, it should when again needed be carefully re-melted, and kept liquid if necessary whilst being used by standing the vessel containing it in a pan of hot water.

§733. Glue is rendered insoluble by the action of 'formalin,' which latter is the commercial name for a 40 per cent. solution of formaldehyde. A good insoluble finish for hat leathers, and for upholstery, bookbinding, and other leathers, where it is desired that the finish should be waterproof, and also that the colour should be fast to rubbing, may be made by taking advantage of this property of formalin. To 100 parts of a 2 per cent. solution of a gelatine of good quality, 5 parts of a 40 per cent. solution of formaldehyde is added, and a light coat of this season is given to the leather; the leather being then dried out in a fairly warm stove in order to drive off the excess of formaldehyde. Only sufficient of the finish for the requirements at the time of making it should be prepared, for the reason that during a long standing the formaldehyde is steadily acting upon the glue and making it insoluble, so that when the mixture has become set, it is impossible to again re-melt it. If desired the gelatine solution may be applied first to the leather, afterwards making the application of formaldehyde. The leather should be finally dried out at a moderately high temperature.

§734. Isinglass.—Isinglass or Fish Glue is now being somewhat extensively employed in finishing. It is prepared from the 'sound,' 'maw' or swimming bladder of various kinds of fish, the

sounds being simply dried, in which condition it is exported. The best isinglass comes from Russia and is prepared from the sound of the sturgeon. Brazilian isinglass is a much whiter coloured product than the Russian variety, and in all probability has been bleached. A common quality of isinglass is also exported from India. The crude material is manufactured into the finished article by cutting with machinery into the thin fine ribbons and strings as purchased.

§735. Isinglass is used in the form of a thin mucilage for sizing skivers and in the finishing of bag, portmanteau, and case leathers.

Linseed.

§736. Linseed.—Perhaps the most common of the various mucilages used for leather finishing, is that obtained from linseed. The mucilage is prepared by boiling whole linseed in water. Linseed is the seed of the flax plant, and it is in the outside shell of the seed that the mucilage is mostly contained. The mucilage is easily extracted by boiling, and there is no necessity for crushing the seed previous to boiling, and no advantage gained by it. A linseed mucilage of a consistency suitable for most purposes of leather finishing can be made by boiling 2½ lbs. of linseed in 10 gallons of water for at least one hour, and then making good the water that has evaporated during the boiling. The undissolved linseed should be carefully strained off.

§737. Linseed makes a mucilage which is both tenacious and possessed of a considerable degree of elasticity, and leather may be finished with linseed without any fear that the finish will crack on bending. As a bottom for leather before staining (§577) linseed mucilage is exceedingly useful, effectually covering up bad grain. And unlike the starch, farina, &c., mucilages, (§768), which do not take dye readily, the mucilage of linseed is particularly suitable as a bottom on account of the readiness with which it is dyed.

§746. In the finishing of skivers for hat leathers, the application to the goods in their damp condition after striking out from the dye-bath, of a 10 per cent. solution of Algin to which a little starch has been added, has the effect of filling up the open poreous grain surface, and also to a material extent of hiding faulty grain. The goods when removed from the boards after striking-out and drying are almost finished and simply require rolling, after the application of a little gelatine, isinglass or a little more of the mucilaginous mixture.

§747. In the finishing of the flesh side of skivers, calf grains, etc., for hat leathers, Algin in 5 per cent. to 10 per cent. solution is to be recommended. A little French chalk should be added when a white flesh is required. This application to the goods on the flesh side brings about, after rolling, a well finished leather; the mucilage, possessing considerable elasticity does not break up to the extent that is observable when linseed mucilage is employed; also the flesh is rendered quite smooth.

§748. Irish Moss and Algin can also be used in about 5 per cent. solution for filling up the grain of skivers, roans, Persians, and calf grains to be finished plain for bookbinding and upholstery purposes. The addition of a little colour solution, sufficient to tinge the Algin or Irish Moss solution is advisable. It must be noted however that only Acid colours (§330) are permissible for this purpose, the Basic colours (§301) are precipitated.

§749. For use on the flesh side of many leathers, such as hide or kip bellies, shoulders, etc., where a smooth flesh is required Irish Moss and Algin are excellent materials for this purpose; and particularly so when the addition of French chalk, whiting, or other pigment is required in order to produce a white flesh. The coarse fibrous flesh of such leathers as hide bellies, shoulders, hide fleshes, etc., glassing down perfectly smooth.

§750. Irish Moss and Algin may also be used with advantage as thickening agents for dye solutions used in staining, instead of glue, gelatine, linseed, etc., which are commonly used for the purpose (§§586, 736).

GUMS.

§751. GUMS.—This is a general term applied to certain exudations from trees and plants. The number of gums that are available in leather finishing is considerable, but unfortunately few of these are suitable for employment in leather dressing on account of the non-elastic brittle films they leave when dried on the leather.

§752. GUM TRAGACANTH is the exudation from a tree-trunk that grows in the East; the exports of it are chiefly from Central Asia and America. When dissolved in water it makes a good mucilage. There are three varieties of gum tragacanth, namely: 'leaf gum,' which is in the form of irregular curled strips; 'vermicelli gum,' in long, thin, cylindrical strips; and 'hog gum.' The last of these is considerably adulterated and is a very inferior gum. Gum tragacanth is often used as a substitute for linseed in preparing leather previous to staining, and for thickening-up a dye solution before its application in staining. It is sometimes used as a finish for calf when this is dressed for boot upper-leathers. A thin solution, a solution of about 1 per cent. strength is brushed over the leather, the leather being afterwards sammed, and then glassed to raise the desired 'face.' It is also used as a constituent of the sizes used upon black curried leathers, wax calf, kips, splits, etc. It finds a very limited application amongst the lighter leathers, such as used for bookbinding, upholstery, etc.

§753. Gum tragacanth is exceedingly difficult to dissolve. Even after boiling in water for as long a period as 48 hours, many samples of this gum refuse to entirely dissolve. The best way to treat it is to place a suitable quantity, say 1 lb., of the gum in a large earthenware jar, to fill up the jar with boiling water, to stir and then to allow to stand. At the end of about 48 hours enough of the gum will have dissolved to furnish a jelly sufficiently thick for use. This being removed, the jar should be again filled with boiling water and allowed to stand, when a second jelly for use will be obtained. And so on even to filling up the jar and obtain-

ing jellies even 30 or 40 times before the whole of the gum tragacanth has been exhausted. The mucilage thus formed is generally quite thick enough for all ordinary purposes.

§754. GUM TRAGASOL is a comparatively new material for use in sizing and finishing. It is prepared from the pip or seed of the locust bean. The fruit of *Ceratonia siliqua.*

§755. The seeds of the locust are extremely hard, and the husk and germ cannot be removed by the ordinary processes of milling which fail to touch them; hence, special processes of treatment had to be devised. The seeds are split by a disintegrator, and the germ, which is more or less broken by this treatment, is separated in a grading machine, leaving the two halves of the seed with the adhering husk intact. The husk is then ground off between mill-stones, and that on the edges of the seed removed by treatment in perling mills, leaving the cotyledons in the form of small circular white discs, somewhat like buttons; the gum is extracted by treatment with water under steam pressure.

§756. Tragasol is sold in the form of a stiff opalescent jelly, resembling Tragacanth paste in appearance, but in properties it is quite different.

§757. When treated with water Tragasol does not dissolve in it, but after a few minutes stirring the water is taken up by the gum and the mass is almost as stiff as before. It is particularly important therefore when using this mucilage to take particular care that the mixing operation is properly performed.

§758. The chief advantage of Tragasol over many other mucilages is the particularly strong filling power and the great elasticity it possesses. It is a very useful mucilage for use on the flesh side of heavier leathers such as strapping leather, being a remarkable binding agent for the pigments used in flesh finishing, *e.g.*, China Clay, French Chalk, etc. In the finishing of flesh splits it is particularly useful, being best applied in conjunction with a small quantity of Gelatine.

§759. Tragasol is useful as a grain finish for many leathers, for example as a plain finish for skivers, roans, calf, etc., for hat, bookbinding or pocket-book leathers, used either alone or in con-

junction with starch, isinglass, or gelatine, it makes a finish that will stand the action of perspiration and rubbing to a remarkable degree. For this purpose it may be applied immediately after dyeing and striking out, and before drying, or it may be applied to the dry leather. This material is also useful in finishing wax leathers (Chapter XXVI).

§760. Gum Arabic and Gum Juniper find very limited application in leather finishing, their principal disadvantage being that neither of them furnishes a mucilage that is sufficiently flexible for the majority of the purposes for which gums are applied to leather. The ideal gum as a finishing material is one that will produce a mucilage that will cover-up defects, fill up the grain of the leather, and be elastic enough not to break or crack when the leather is bent or pulled.

§761. Gum may be used as a seasoning when the leather upon which it is used has to be glazed by machine, and in the case of heavy upper leathers which are to be glazed or rolled gum tragacanth is the season that is often employed. It is however not nearly so satisfactory for this purpose as albumen.

§762. Shellac.—This is a colourless resinous substance which exudes from the twigs of certain Indian trees in consequence of the perforations of a small insect. The insect forms the gummy substance into regular cells, and it forms a coating round the body of the insect, which dies after depositing its eggs. Shellac is insoluble in water. When used as a finish for leather, either by itself or in conjunction with other materials, it must be dissolved either in a warm alkaline solution, *e.g.*, ammonia or borax, or else in methylated spirit or alcohol.

§763. There are two sorts of shellac known to commerce; a bleached variety sold as yellow or white shellac, and a dark-coloured kind, not bleached, that is sold as ruby or orange shellac.

§764. In leather finishing shellac is exceedingly useful; it is one of the most important ingredients of a finish for leathers that are required to be waterproof, or fast to rubbing.

§765. For the finishing of light coloured leathers, the white or yellow shellac should be employed. This variety has been bleached by exposure to the sun. The dark-coloured, ruby shellac is sufficiently good for finishing blacks and dark-coloured leathers.

§766. Shellac is best dissolved in methylated spirit, and diluted as required, with water to which has been added a little weak ammonia. The shellac, say 1 lb. of it, along with about half a gallon of methylated spirit, should be placed in a large earthenware jar fitted with an air-tight stopper, and allowed to stand in a warm place until the whole of the solid matter has dissolved ; this generally requires 2 or 3 days.

§767. This gum is largely used as a finish for blacks for accoutrement work, harness, etc., also in the finishing of upholstery leathers, where it is very necessary that the colour should be fast to rubbing. For this purpose it answers exceedingly well. A typical formula is given on page 282.

STARCHES.

§768. STARCHES.—Starch is an organic compound which, with certain exceptions, exists in all green plants.

§769. WHEAT STARCH.—A very stiff mucilage is obtained from wheat starch when boiled in water. Starch is a very useful finishing material on some classes of leather, the mucilage that it affords being cheap, colourless and transparent. The best method of preparing the mucilage is to mix the ordinary starch of commerce with cold water to a thin cream, then to add boiling water to the mixture, and to stir carefully in one direction until the white solution gradually changes to a clear opalescent mucilage.

§769. Starch is used as a finish for hat leathers, a thin solution, of generally from 1 to 2 per cent. strength, being applied to the leather, and the leather being then dried out. When dry, the leather shows a pretty glaze finish which is fairly insoluble, particularly if the leather has been dried out at a high temperature. One of the chief advantages of starch as a mucilage for leather is that after the application of the mucilage, the leather is quite free from any white deposit showing up in the interstices of the grain of the leather.

§771. Starch makes a good finish for strapping, bag-hides, etc. Made use of as just described, it is also largely employed for a finish to paste-grain and plain skivers.

§772. POTATO STARCH.—This starch, commercially known as 'farina,' is obtained from the 'tubers,' (the short, thick, fleshy, underground stems), of the potato plant.

§773. Farina, like wheat starch, yields a transparent mucilage. When boiled in water it produces a jelly that is slightly stiffer than the wheat-starch jelly. Many dressers of heavy-stained goods such as bag and legging hides make use of it as a grain finish in preference to wheat starch. It does not however possess any great advantage over the commoner starch except that it is slightly cheaper and somewhat easier to prepare. Farina makes a nice finish for 'self-colour' goods; for goods that is, that are dressed in their natural colour. Some dressers use it also as a bottom previous to staining, especially when the staining operation has to be done on the dry leather after dressing. It is employed also as a finish for skivers and 'Persians' to be finished 'plain.'

§774. INDIAN-CORNFLOUR STARCH, (MAIZE STARCH); RICE STARCH; SAGO STARCH.—The first of these starches produces a mucilage that is not quite so stiff as that obtained from wheat or potato starch. The other two starches need mention only.

§775. As already mentioned, the principal objection to starches for use with many classes of leather as a finish is that when applied even in comparatively weak solution (2 to 3 per cent.), a considerable stiffening of the leather is caused and the resulting finish is inclined to be brittle. The defect can be counteracted however to a considerable degree by the addition of a small quantity of glycerine to the finish.

WAXES.

§776. WAXES.—The principal waxes used in leather finishing are beeswax, carnauba wax, and Japan wax. It is only to a limited extent that the waxes are employed, in the finishing of plain goods, such as legging, bag and purse hides, etc.

§777. Waxes are usually applied to leather in the form of a mixture of soap and wax, united by being boiled together along with the required amount of water; the mixture being afterwards allowed to set to a thin jelly. A typical formula is given on page 282. Constant stirring is necessary during the setting to prevent the wax separating from the soap.

Application of the Various Finishing Materials.

§778. The whole of the more important materials made use of in leather finishing are above referred to. In the seasoning of various classes of goods it is usual to make a mixture of several materials according to the particular result desired. Such a mixture in practice is very frequently made up of a number of ingredients which are of similar nature one to another, and which moreover, more often than not, affect one another injuriously. A finish, or seasoning mixture, should contain no more ingredients than are necessary to bring about the result that is intended.

§779. By way of example a few recipes of seasoning and finishing mixtures for various classes of goods are subjoined.

SEASONING RECIPES.

Coloured Goods (Glazed).

(1.)

8 ozs. Egg Albumen.

5 pints Milk.

Made up to 5 gallons with water.

Dissolve Albumen in cold water.

(2.)

10 ozs. Casein.

½ oz. Borax.

3 pints Milk.

Made up to 5 gallons with water.

Dissolve Casein by boiling in 3 gallons of water to which the Borax has been added; then cool, add Milk, and make up with the water.

(5.)

10 ozs. Linseed or Irish Moss.

2 pints Milk.

5 ozs. Egg Albumen.

5 gallons Water.

Boil Linseed or Moss in 1 gallon water for ½-hour, strain through cotton gauze, and cool. Dissolve Albumen in cold water. Mix above together, add Milk, and make up to 5 gallons with water.

(6.)

5 ozs. Algin (solid).

2 pints Milk.

8 ozs. Blood Albumen.

5 gallons Water.

Dissolve Albumen and Algin in cold water by allowing to stand some hours, strain through cotton gauze, add Milk, and make up to 5 gallons with water.

PLAIN FINISHES (FOR HAND OR MACHINE GLASSING)

(7.)

16 ozs. Linseed, or Irish Moss.

2½ pints Milk.

5 gallons Water.

Boil Linseed, or Moss, in water for ½-hour, strain and cool, finally adding Milk and water to make up to 5 gallons.

(8.)

10 ozs. Isinglass or Gelatine.

2½ pints Milk.

5 gallons Water.

Soak Isinglass or Gelatine, in water over night, dissolve in jacketed pan next day, then cool, and add Milk and water to make up to 5 gallons.

BLACK GOODS (GLAZED).

(3.)

10 ozs. Logwood Extract.

4 ozs. Ferrous Sulphate.

3 pints Milk.

5 pints Blood.

5 gallons Water.

Dissolve Logwood Extract in a small quantity of boiling water, dilute to about 3 gallons with cold water, and add Ferrous Sulphate separately dissolved in a little cold water. Finally add Blood and Milk, and make up to 5 gallons with water.

(4.)

5 ozs. Corvoline B. (B.)

3 pints Milk.

5 pints Blood.

5 gallons Water.

Dissolve Corvoline in a little boiling water, then cool and add Blood and Milk; making the whole up to 5 gallons with water.

Wax Finish (for Brush or Hand Polishing).

(9.)

10 ozs. Carnauba or Bees Wax.
10 ozs. White Curd Soap.
3 ozs. Glycerine.

Boil the mixture in 1 gallon water until dissolved. Stir occasionally during the cooling, add sufficient water to make up to 1 gallon and afterwards Emulsify (see §612).

Shellac Finish.

(10.)

6 ozs. Shellac.
½ oz. Venetian Turpentine.
½ oz. Glycerine.
3 pints Methylated Spirits.

Place the mixture in a stoppered vessel and allow to stand in a moderately warm place for about 24 hours until dissolved, occasionally shaking the vessel.

CHAPTER XVI.

FLUFFING.

§780. FLUFFING:—To fluff a skin is to subject its flesh side to the action of a revolving 'fluffing'-wheel. The operation is necessary when the flesh side of the skin is to have a fine nap, or downy surface. It is also required when a skin has not been shaved (§62), and is consequently uneven in substance.

§781. The fluffing-wheel or 'fluffer' is either an emery wheel, or a wooden pulley mounted on a short shaft and 'dressed' with emery powder. To make a fluffer of a wooden wheel its face has to be covered with hot glue, and emery powder sprinkled upon the face whilst the glue is still hot.

§782. In the case of a light skin which is of uneven substance the action of a coarse-emery fluffer levels the substance sufficiently to allow of the skin being glazed and for it to present a satisfactory finished appearance. Fluffing also smooths up the flesh side, and removes any marks left by bad shaving (see §99).

§783. The fluffing-wheel is partly covered over with a wooden or metal cover, and a segment only of the wheel is left exposed (Fig. 138). The workman places the skin to be fluffed, flesh side downwards, over the projecting side-tables and over the revolving wheel, and, holding the skin against the framing to prevent its being carried away from him by the drag of the wheel upon it, he presses the skin where it is over the wheel, against the wheel, using a leather or woollen pad to protect his hand from inadvertent contact with the wheel. In this manner the skin is

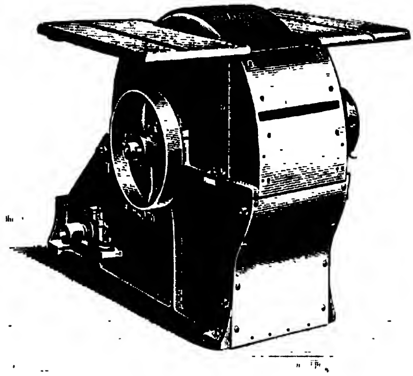


Fig. 138.

worked in all directions until the whole of the flesh side has been gone over, that is to say has been fluffed. The dust, 'fluff,' is generally got rid of by means of a fan fixed in the framework of the machine, which draws it off and blows it through a wooden or iron pipe into some receptacle placed outside the building. The speed of the fluffing wheel is usually about 350 revolutions per minute.

§784. The above is the old-fashioned fluffer. Its great disadvantage is that the operator has not in view the side of the

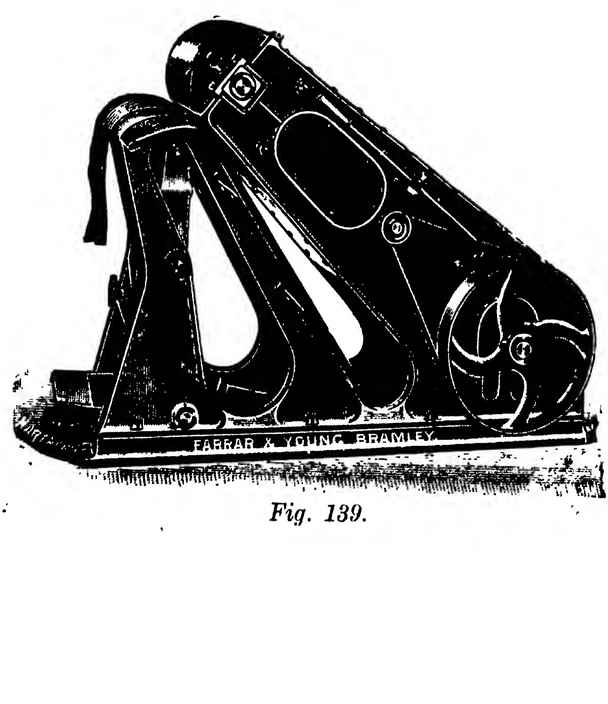


Fig. 139.

skin he is working upon, but must lift the leather off the wheel, and turn it over to see if his work is proceeding satisfactorily. Obviously such a machine needs improving and can be improved to advantage, and a number of machines of various constructions have been placed upon the market in which the disadvantage spoken of has been overcome.

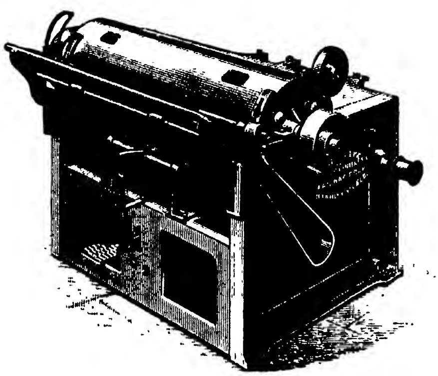


Fig. 140.

§785. Three distinct types of the newer fluffing machines are represented in the Figs. 139, 140, 141, & 143. In these machines the skin to be fluffed is passed, flesh side uppermost, over a table, and is brought into contact by means of a brush connected with foot treadle, with a revolving emery-covered cylinder, against which it is worked bit by bit in a manner somewhat similar to that

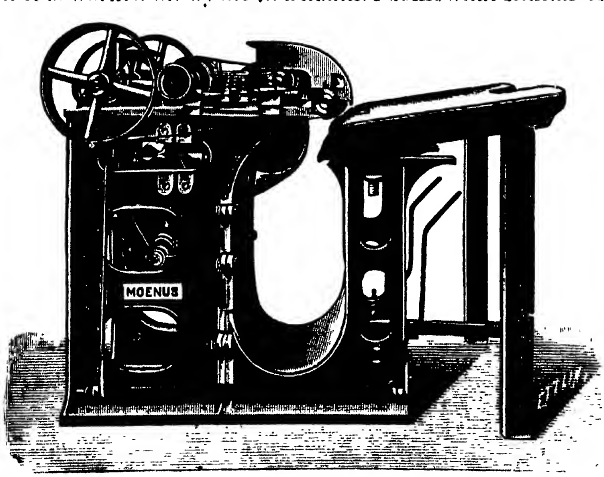


Fig. 141.

required in operating the shaving machine (§90). The fluff is removed by fan, as explained above in respect of the older style of machine.

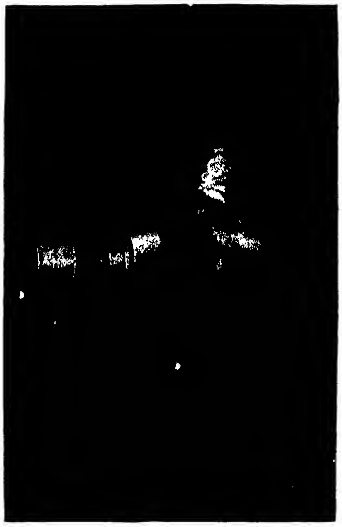


Fig. 142.

§786. In these machines the cylinders are, as stated, 'emery-covered.' They are not however as in the case of machines with the ordinary width (about 30 inches) of wheel, 'dressed' with emery powder as the rollers are in the older machines (§783), nor is there any glueing, but emery paper or cloth is made use of, and this is attached to the cylinders by clips. The usefulness of this is evident, for the emery sheet can be changed, and a fine or a coarse emery substituted respectively for a coarse and a fine emery. The change can be effected without trouble in a few moments.

§787. Still, solid wheels can be employed in these machines In Fig. 142 the wheel is a solid wheel. And in the case of chamois, deer skins, etc., it is usual to fluff with a solid emery-wheel or a solid sandstone wheel.

§788. When a fine-nap surface is desired for the goods it is usual to first fluff with coarse emery, of 70-80 'grit,' and follow this by a fluffing with a finer emery, of about 140-150 grit, finishing finally, in the case of alum and chamois goods dressed for Suede gloves, with a fine stone wheel or a wheel covered with flour-emery. Fig. 142 shows a solid emery-wheel fluffer, as used for alum kid and chamois leather.

§789. The solid emery wheel is often spoken of as a 'Buffing Wheel,' and is in common use for lightly 'buffing' the grain

side of goods. The machines Figs. 139, 141, 143, are used for this purpose, and are particularly useful in 'patch buffing' kips, etc., intended for grain finish.

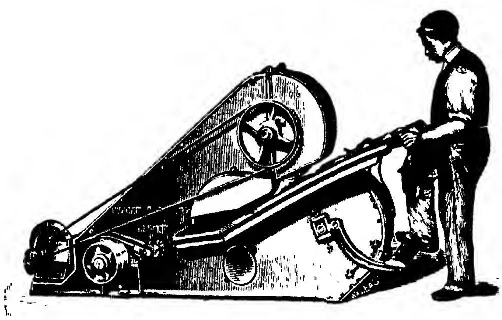


Fig. 143.

Bower Glazing Machines.

CHAPTER XVII.

SEASONING AND GLAZING.

§790. SEASONING.—'Seasoning' is the application of a 'season' or 'finish' to the grain side of the leather previous to glazing or finishing. This subject has already been partially dealt with in Chapter XV. The season is usually applied with a sponge, or a velvet pad, a light coating of the mixture being thus given to the grain surface. After the application of the season it is customary, and generally advisable, to get the season well into the leather by rubbing over the leather with the hand. Several machines have been introduced from time to time to take the place of the simple hand operation, but up to the present no machine has been generally adopted. Probably the chief reason for this is that the machines invented up to now 'possess no brains,' and cover the whole surface of the leather with an equal coating of the seasoning mixture, making no discrimination between the amount given to the flanks and open porous parts of the leather, and that given to butt, ridge, shoulder, and other tighter and denser portions of the surface. Moreover a machine that could successfully compete with the operation as performed by hand would have to work with extreme rapidity, as well as be neither itself high-priced, nor expensive in its working; for the hand operation being of a non-skilled character is not a costly operation.

§791. HAND GLASSING. — The oldest of the methods of obtaining a polished surface on leather was by 'glassing' as a hand operation. Hand glassing or 'pebbling' is still resorted to in dealing with such leathers as shoe calf, where a very bright gloss or 'face' is not required. The operation consists in working over the surface of the leather with a piece of thick plate-glass or

with a pebble, fixed in a 'slicker' handle (see Figs. 37 & 38). Further description is unnecessary.

§792. Glazing by Machine.—The Hand 'Jigger' is perhaps the oldest form of glazing machine. It consists, one form of it, of a base-piece (see Figs. 144 and 145), which is fixed to the joists of the ceiling and which has attached to it a spring of the type of the ordinary carriage-spring. An arm is jointed to the centre of the spring and is free to swing in the direction of the length of the spring. The arm at bottom carries a cylindrical piece of glass, or of hard wood, boxwood, or lignum vitæ. D in Fig. 146 is a such hard-wood cylinder, termed a 'dummy.' These cylinders are the glazing tools, and are capable of a limited amount of vertical adjustment. On a table or bench standing on the floor or ground, the 'bed' of the jigger is fixed, its length being in the same direction as the length of the spring, so as to correspond with the swing of the arm. Usually the bed is a piece of lignum vitæ, supported only at its ends, its unsupported length thus having an amount of spring of its own. The leather to be 'jiggered' is laid on the bed of the machine; the operator by means of a handle conveniently placed moves the jigger arm backwards and forwards; and the leather by this to and fro motion of the tool upon it has a glaze imparted to its surface. By the yield of the spring at the top of the arm and the yield of the lignum-vitæ bed, the necessary shortening takes place as the arm at each stroke becomes vertical. By the adjustment of the tool, lowering it a little, or raising it a little, its pressure upon the leather is increased or lessened, the adjustment being determined by the particular amount of glaze required on the leather. The swing of the jigger arm is effected with the right hand; with his left hand the operator slightly shifts the leather after each

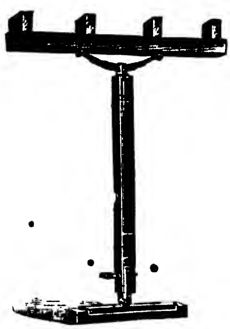


Fig. 144.

stroke, thus bit by bit bringing the whole of the skin he is working on under the action of the glazing tool.

§793. Fig. 145 illustrates the working of a jigger. Instead of the spring attachment just described to the jigger arm, the arm is often simply attached to a long ash-wood pole. The ash-pole gives the necessary spring. In the construction represented in the Fig. 145 the ash spring is that piece of the jigger that runs across at the top and which is pivoted at each end. The wood 'gives' between the pivots.

Fig. 145.

§794. The hand-jigger, notwithstanding the crudity of its construction, is still largely used, especially amongst the finishers of morocco leathers.

§795. So far the hand-jigger has been referred to only as employed for glazing. By a change of tool however it serves for 'tooth rolling,' and also for 'printing' (see Chapter XVIII).

§796. The tooth-roller is a cylinder of boxwood, circularly ribbed or grooved. It is a 'roller' which in use does *not* roll, but is held rigid in the jigger arm, and its action is to produce by pressure, when the arm is worked, parallel lines upon the leather. This tooth-rolling breaks the grain of the leather

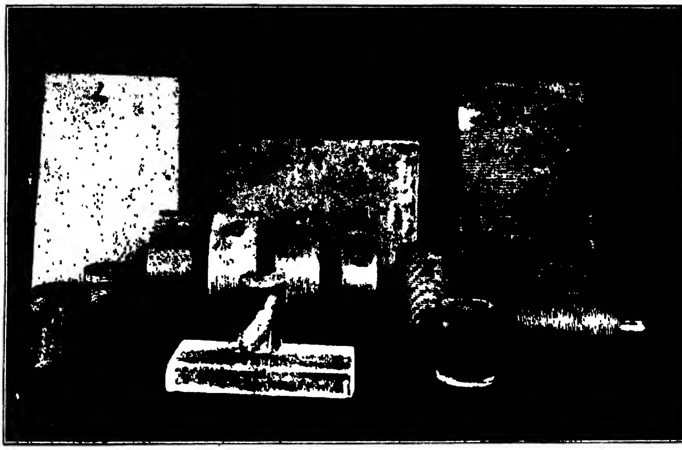


Fig. 146.

somewhat, and prepares the way as it were for the operation of 'graining,' which always follows, and it helps to bring about a regularity in the grain effect when the skin is finished. It also assists in obviating piping in a skin of loose texture. The cylinders are generally of one width, usually 1½ inches, and go by numbers, the lowest-numbered roller having the greatest number of ribs to the inch. Fig. 146 shows various rollers. A is a No. 2 roller, B a No. 4, C a No. 7, E, F, and G are ribbed rollers for use in a 'grasshopper' (*see* §801) or other power machine. The 'dummy' D has already (§792) been spoken of.

§797. The hand-jigger is a useful machine for printing or embossing leather (see Chapter XVIII). A 'printing' roller, a straight-grain roller, is shown at K in Fig. 146, and an illustration of pieces of printed leather is given in Fig. 157. The only difference between the operations of glazing and printing, is that in the latter the cylindrical tool is not held stationary but revolves as the arm is pushed across the prepared skin, in the direction of course in which the grain has to be; the printing being to the width of the roller at each stroke of the jigger-arm, about 4½ inches.

§798. Pendulum Jigger or 'Buck.'—The pendulum jigger (Fig. 147) is driven by power and is consequently a step in

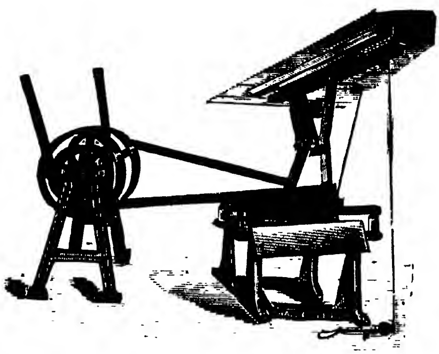


Fig. 147.

advance on the hand jigger. The driving-wheel of the machine has a crank of long throw, and a connecting rod from this to the jigger arm gives to the arm a stroke of the length of the machine bed, and a corresponding travel to the glazing tool. The 'buck' is still largely used, especially for the glazing of coloured fancy leathers, black glazed sheep, etc., and does excellent work, giving a finished result which it is difficult to obtain with the more modern machines. The principal objections to the machine are the amount of space it occupies, usually about 15 feet by 5 feet, and the noise it makes in working. The Fig. shows a double jigger, for two operators. The pressure of the tool on the leather is controlled by treadle.

§799. Glazing machines of other methods of construction and differing in their details are represented in Figs. 148, 149, and 150. The good work turned out by the hand jigger and the 'buck' has been referred to. This is possibly due in some extent to the fact that these machines are of wood, a material which is alive and resilient so to speak, as compared with the dead and inelastic cast-iron of which as a rule machines are mainly constructed.

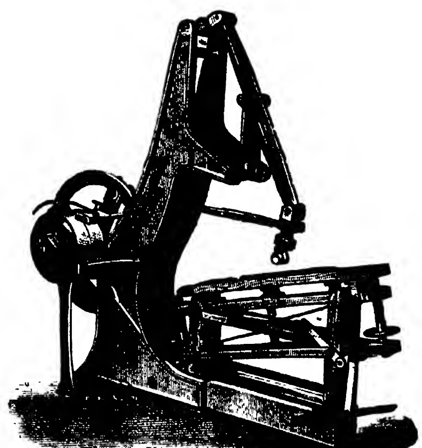


Fig. 148

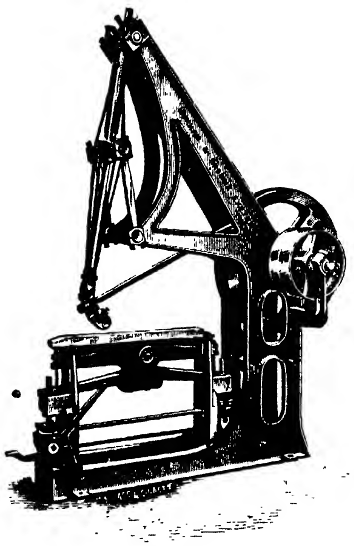


Fig. 149.

In the resilience of the wood there is a yielding which as it were accords with the inequalities of the leather; in the rigidity of the iron there is not this accordance.

§800. Of later years wood glazing-machines of the 'Bower' (from the name of the manufacturer) pattern have been largely employed: especially in the glazing of chrome leathers. Fig. 152 shows a wooden Bower machine (see also the illustration facing page 289). A feature of this machine is the spring placed at the top of the upright. In England, where the climate varies so much, and the wooden supports of a machine shrink or swell according as the air is dry or moist, machines constructed of wood are constantly requiring re-adjustment. A combination of iron and wood in the glazing machine was suggested by the writer some five or six years ago, the idea being to retain the wooden arm and the wooden legs under the bed of the machine but to make the frame of iron. Machines thus constructed are shown in Figs. 150 and 153. The beds of glazing machines are made both horizontal

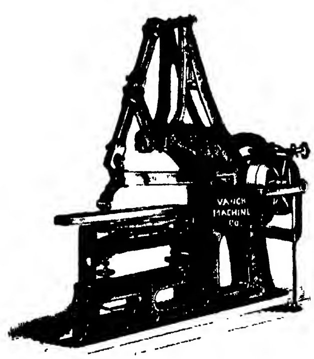


Fig. 150.

(Figs. 149 and 150), and inclined (Figs. 148, 152, 153). The machines of horizontal bed are generally employed in the

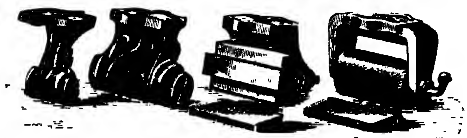


Fig. 151.

glazing of Persians, basils, etc., and machines of inclined bed in the glazing of chrome glacès.

Fig. 152.

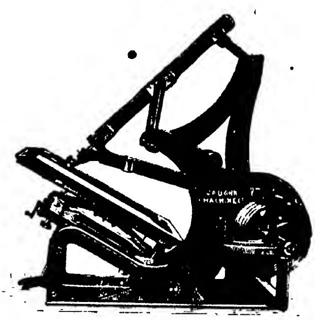


Fig. 153.

§801. Glassing by Machine.—In glassing as distinguished from glazing, a different type of machine is generally employed. Figs. 154, 155, show glassing machines. Machines of this type are often termed 'Grasshoppers.' Glassing is usual upon hides, hide shoulders, bellies, wax calf, kips, etc. Much

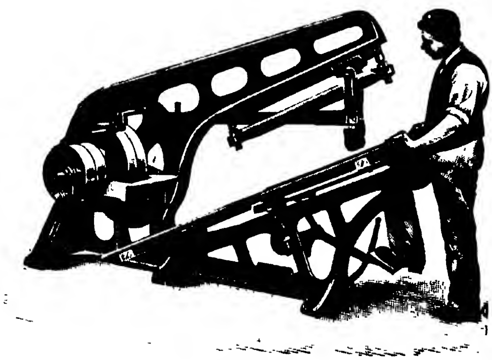


Fig. 154.

of this work is still done by hand. A flat glass (J, Fig. 146) is the tool generally used. The grasshopper is a favourite machine for use in printing, (§811) also for glassing black curried leathers, *e.g.*, wax calf. When used for the above purposes the machine is generally worked at a speed of from 50 to 80 strokes per minute. One of the disadvantages of this type of machine over the pendulum type is the slide up and down which the carriage of the tool holder runs; this when at all worn sets up vibration.

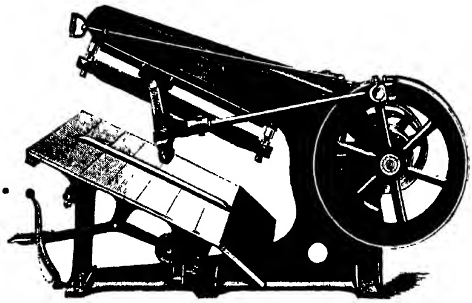


Fig. 155.

§802. Rolling.—Rolling the grain surface of light skins in order to get a smooth plain finish is often done on a glassing machine (§801), the glazing tool being then replaced by a smooth brass or gun-metal roller. Fig. 154 shows the 'Grasshopper' machine being used for this purpose. Rolling machines of the Pendulum type are also extensively used, and for some classes of work are to be preferred. Fig. 156 shews a machine made for heavy work; the shortness of the overhang of the frame allows a very heavy pressure to be applied.

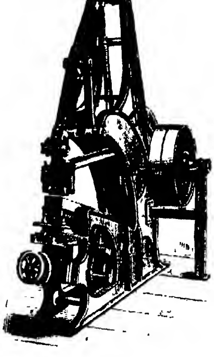


Fig. 156.

§803. Adjustments of Glazing Machines.—The methods adopted by the various makers for adjusting the table of the glazing machine differ in detail, but the more general method is by means of two hand screws which can be moved at will so as to lower or higher the table. The table

on which the skin to be glazed rests is brought up to the glazing tool by means of a lever actuated by the foot; the lever being usually placed at the head of the table in the case of machines with sloping tables (Fig. 148) and at the side in the case of machines possessing level tables.

§804. SPEED.—The speed at which glazing and glassing machines are best worked depends somewhat on the particular type of machine being employed and the class of goods being operated upon; 120 to 150 strokes per minute in the case of glazing machines of a type as shown in Figs. 152, 153 and 154; and about 80 to 90 strokes per minute in the case of the pendulum jigger (Fig. 147).

§805. Various tools for use in the glassing machine or in the glazing machine are represented in Fig. 151. The tool on the extreme left is an ordinary glass *glazing* tool; it is a cylinder, of about 3½ inches in length and 2 inches diameter. The tool next to it is also a glass cylinder, longer than that just referred to though of same diameter; it is about 4½ inches long and is used for *glassing*. The next tool is a piece of thick plate glass; it is used for glassing coloured leathers, and for 'glassing down' curried leathers, such as wax kips, wax calf, etc. The tool on the extreme right is a printing roller; or, if without figure upon it, a plain roller for rolling (§802.)

§806. The tools not yet referred to in Fig. 146 are as follows: K is a printing roller; I is an agate cylinder for glazing; J is a glass plate for glassing; and F is a glass cylinder for glazing machine.

§807. The tools in most common use in the glazing machine are the glass or agate cylinders. They are made cylindrical so that when one portion of the tool is worn flat, it can be loosened in the tool holder and turned round a little so as to present another curved portion to the leather, an unused portion.

§808. Agate tools are much more expensive than glass tools, but they do not easily scratch and therefore wear much longer than glass. Both glass and agate cylinders when worn quite out

of truth can be re-ground. The friction in working with either glass or agate is considerable, and the tools become very hot, so hot that there is danger of damage to the goods. Agates become much hotter than glass tools, probably because, not scratching easily, they are used with greater pressure upon them than is put upon glass tools which scratch easily. The nature of the material may also have something to do with it. The heating of either kind of tool is much lessened if the glass or agate is packed into the tool holder with asbestos cloth. Agate tools that have been circularly ribbed like the box-wood tool roller (A, Fig. 146) are sometimes employed; principally when glazing hog skins.

§809. Leather finishers working glazing machines, like other people have their likes and dislikes; some prefer glass rollers, others prefer agate. Glass tools, as a general rule, give a clearer finished result when the goods are at all inclined to be greasy, as, for example, basils, etc. This is no doubt due to the greater heating of agate tools, by which any grease in the leather near the grain surface is so heated as to come through to the surface. The old-fashioned 'dummy' (D, Fig. 146), made of lignum vitæ does excellent work in many classes of machine; by its use a greater intensity of colour in the finished skins is brought about.

§810. Pebbles are sometimes used in the glazing machine. A fine smooth pebble, such as found on the sea shore, is carefully chosen, and is ground into shape so as to fit in the tool holder of the machine. Pebbles are, however, of little value when a highly glazed finish is required; in the glassing machine, however, they are certainly useful.

To face page 299.

Glazing Machine Shop (Skivers and Basils).

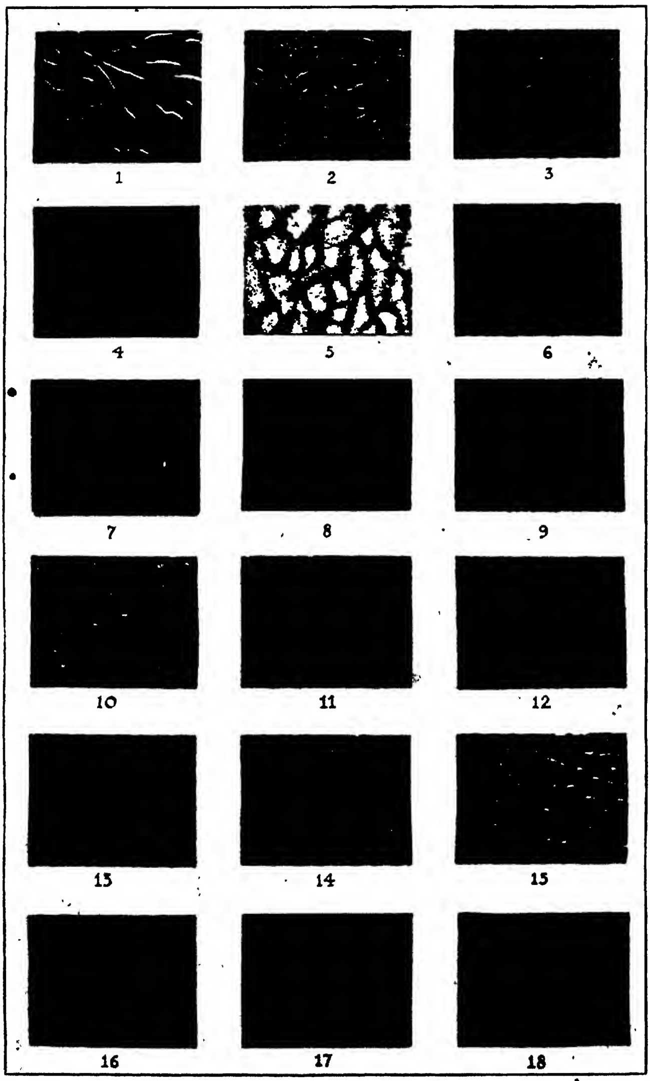
CHAPTER XVIII.

PRINTING AND EMBOSSING.

§811. To 'print' is to reproduce by impression a prepared design or pattern. To 'emboss' is also to reproduce by impression a prepared design or pattern. The difference is that in the case of printing, the reproduced design or pattern is displayed in the actual pressure-marks on the printed surface, these marks are primary; whilst in the case of embossing the pressure-marks are secondary, and simply outline portions of surface not impressed, and the unimpressed portions display the reproduction of the original design or pattern. The pressure-marks being indentations or *depressions*, the unimpressed portions of the surface stand up in higher level, that is to say are in prominence, in other words are embossed. The subject has already been partially dealt with in connection with the hand-jigger in Chapter XVII.

§812. The more usual embossed effects upon leather are the reproductions on inferior leathers, such as sheepskins, cow-hides, kips, etc., of the natural grain of such leathers as seal, alligator, crocodile, etc. As marking by pressure is indispensable to both kinds of design reproduction upon leather, printing and embossing, the term 'printing' is generally applied to both kinds.

§813. Printing as carried out by hand or with the jigger (see §797) is nothing new. The hand method, introduced more than a century ago and still resorted to, consists in rolling the grain surface of the leather over with one or other of the types of hand printing or embossing roller shown in Fig. 158, applying as much pressure as possible. The leather should be in a slightly damp, but equally damp, sammed, condition.



1. Large Flower.
2. Ivy Leaf.
3. Lily of the Valley.
4. Large Dice.
5. Rhinoceros.
6. Straight Paste Grain.
7. Long Grain.
8. Pig Grain.
9. Basket.
10. Baby Elephant.
11. Pebble.
12. Seal Grain.
13. Crocodile.
14. Alligator.
15. Crocodile.
16. Caiman.
17. Crocodile.
18. Serpent.

Fig. 157.

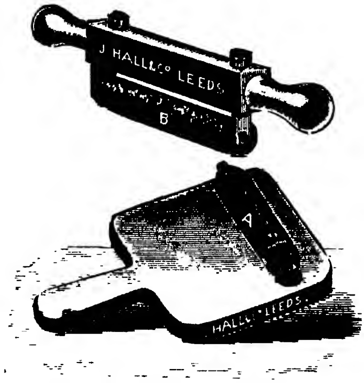


Fig. 158.

§814. The employment of an engraved roller placed in a jigger (see §797) was the next step in the direction of improvement on the hand method.

§815. It is not possible however by either hand printing or jigger printing to get broad or bold effects, such as are represented in Fig. 157 Moreover the goods under treatment are only embossed a few inches at a time; and further, considerable skill and good judgment are required, all of which means cost, to so print that no lines of junction shall show of the successive stages of the working.

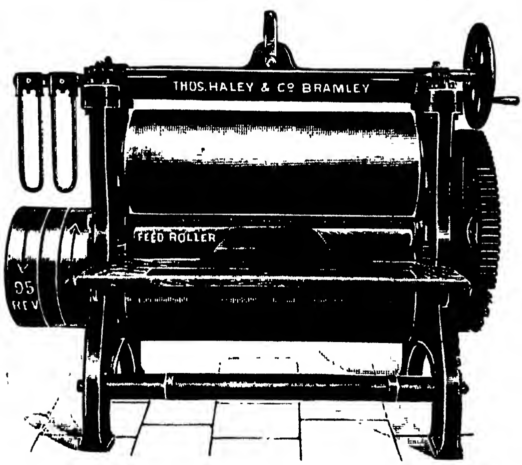


Fig. 159.

§816. Two of the usual types of printing machine in general use at the present time are represented in Figs. 159 and 160. By these machines a whole hide or skin can be embossed at one operation.

§817. In some respects this type of machine resembles the bandknife splitting machine shown in Fig. 8, p. 17. It has, instead of the india-rubber bottom roller D of that machine, a wooden (sycamore) roller. Further it has a printing roller, like, as to position, the sectional roller E of Fig. 8, and a large wooden nipping-roller, analogous as to position to the roller F of the band-knife machine. To the feed roller of the machine represented in Fig. 159 there is nothing in Fig. 8 that corresponds.

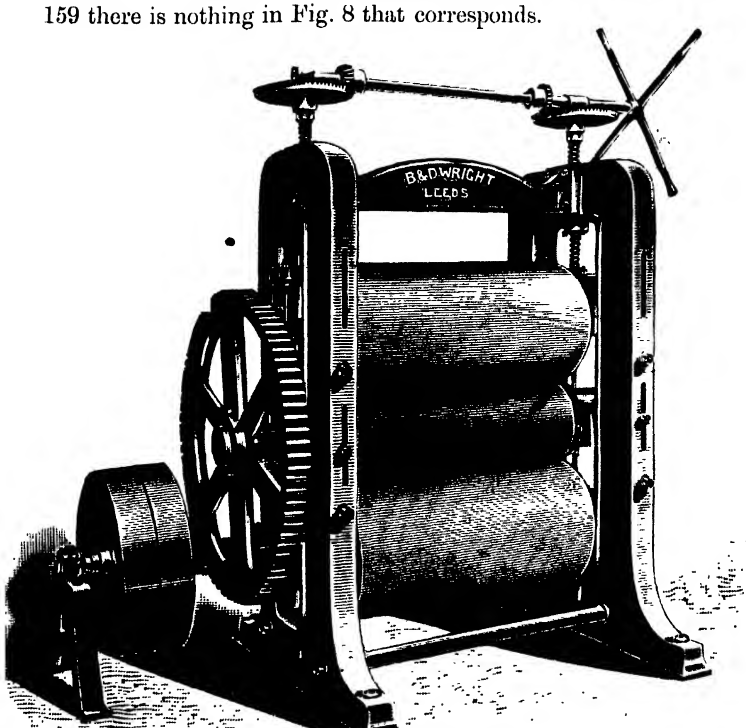


Fig. 160.

§818. The leather to be embossed in the machine is fed into it over the feed roller and under the embossing roller, the requisite pressure being obtained by means of the hand-wheel (see the Fig.), which depresses the upper roller, and tightens up the printing or embossing roller against the wooden nipping-roller. The embossing roller is of about from $3\frac{1}{2}$ to 4 inches in diameter, the sycamore roller is from 18 to 20 inches in diameter.

§819. The embossing roller is generally made up of two parts, a hollow internal portion or mandril, and a sleeve fitting outside of this, the design or pattern to be embossed on the leather being engraved on the sleeve. This method of construction for the roller is a convenient one, as it is thus possible to have several sleeves of different designs, and to substitute one for another on the hollow mandril, the change being effected with but little difficulty. And there is this further utility in the hollow mandril, that a current of steam can be passed through it, and the engraved sleeve can thus be kept heated during its passage over a skin, a procedure which greatly facilitates deep embossing and the production thereby of striking and choice effects.

§820. Embossing rollers are quite commonly produced by electrotype process, which is a very excellent method of manufacture when it is desired to reproduce accurately on a common skin the grain of a rarer skin, as for instance, to reproduce on a skiver the grain of a seal or of a goat skin. Figs. 157 show the reproduction of various embossed grains.

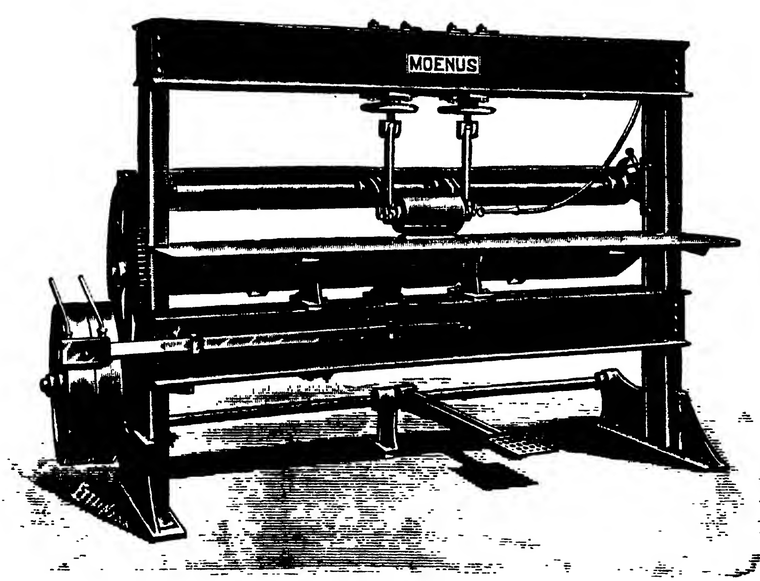


Fig. 161.

§821. In Fig. 161 there is represented another type of embossing machine, made use of for the most part for the embossing of bag hides, levants, &c. The embossing rollers of this machine are made from 6 inches long to 36 inches, and will consequently emboss to corresponding widths of skin. The rollers can be heated by either steam or gas.

§822. One of the latest embossing machines on the market is that shown in Fig. 162. This machine does not emboss from a roller but from an engraved or electrotyped plate. Very perfect reproductions indeed of skin-patterns can be obtained by this method of embossing, better results than seem to be practicable by roller embossing.

§823. In embossing by this machine the skin is placed, flesh side downwards, on the table extending horizontally in the central portion of the machine from side frame to side frame. This table, in its centre, has an opening (see the Fig.), which corresponds to the travel of the roller beneath it. The roller is mounted on a car (call it), and the travel of the car is brought about by means of a screw extending, like the table, from side frame to side frame of the machine, and having its bearings in the side frames. The opening in the table is of the same width as

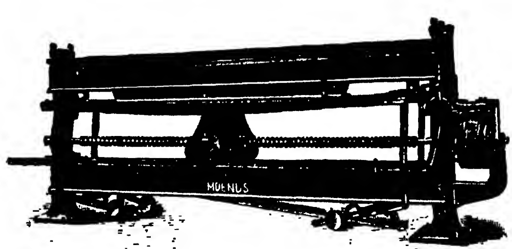


Fig. 162.

the car-roller. The embossing plate, which faces downwards, is fixed to a hollow box which is held by brackets bolted to the top stretcher of the machine. The machine being set in motion, the table with the skin over it is automatically lifted towards the

embossing plate which is heated either by gas or steam in the hollow box to which it is a fixture. The car-roller now travelling by the revolution of the screw, presses the skin forcibly against the plate, the embossment of the skin being thus effected. The car-roller on reaching the end of its path stops automatically; the table is lowered slightly so as to release the skin which is shifted a distance corresponding with the width of the plate so that a further portion of it may be embossed. The embossment is in strips as it were, lying side by side, the strips being about 12 inches wide and as long as the width of the skin.

§824. The Fig. 163 shows another type of machine for embossing by plate, the pressure being applied by car-roller through an opening in the table, as described §823.

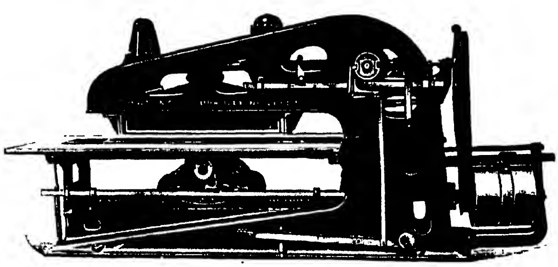


Fig. 163.

§825. Another type of embossing machine that has just recently been placed on the market is shown in Fig. 164.

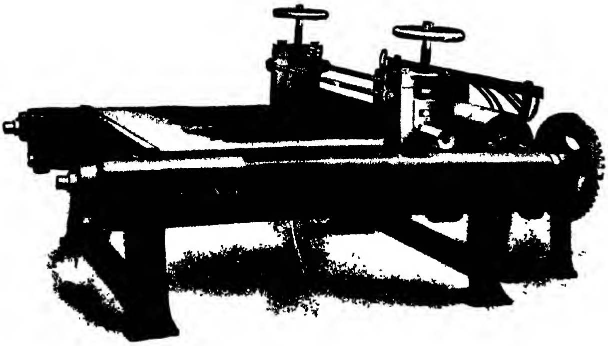


Fig. 164.

In this machine the skin to be embossed is laid grain side uppermost on a fixed table which is covered with compressed cork. By means of a roller fixed to an endless screw the printing roller is made to travel from one end of the table to the other thereby passing over the leather. The requisite pressure is applied by means of the hand screws shown in the illustration and the machine is fitted with stopping and reversing gear.

§826. In America the embossing of skins is universally done by a plate, the skin to be embossed being placed in a press, and the needful pressure obtained by screw if the press is a screw press or by hydraulic power if the press employed is an hydraulic press. In the case of small skins the plate is large enough to cover the whole skin, and the embossing of the skin is effected at one operation.

To face page 307.

Finishing Machinery.

CHAPTER XIX.

Brushing, Rolling, Ironing, and Calendering.

§827. Brushing.—Brushing by machine is now habitually practised in preference to hand brushing. Brushing is an operation which many classes of coloured leather are subjected to. The leather after seasoning with a suitable mixture, (see §790) undergoes this operation in order to give it the requisite degree of polish for the particular finish intended for it.

§828. There are several types of brushing machine in the market, the oldest being simply a cylindrical brush rotated by power, the skin to be brushed being placed on a table under the revolving brush, and the table being raised or lowered by foot lever (as with a glazing machine) to bring the skin under the action of the brush or to remove it from that action as required. The skin is shifted about by hand until the whole of it has been worked over by the brush. A brushing machine of this type is shown in the illustration facing this page, being the machine that is exactly in the centre of the photograph. Fig. 165 is an illustration of a much improved type of brushing machine, and its superiority was quickly recognised by American manufacturers. The brush in this machine, besides having rotary motion, also has a backwards and forwards recipro-

cating motion, so that a skin is brushed over with much greater

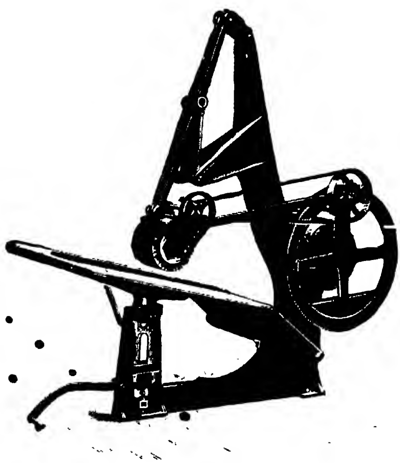


Fig. 165.

rapidity than is possible with the older type of machine. The length of the stroke of the machine is from 30 to 35 inches, and the operator works from the centre of a skin to its edges, changing the position of the skin constantly so as to bring every portion of it in succession under the action of the brush. The machine on the right hand in the illustration facing page 307 is another representation of this type of brushing machine.

§829. Rolling.—In the 'plain' finishing of leather, a smooth plain surface is required for it; and the ordinary procedure, after a light coating of some mucilage has been applied to the grain side

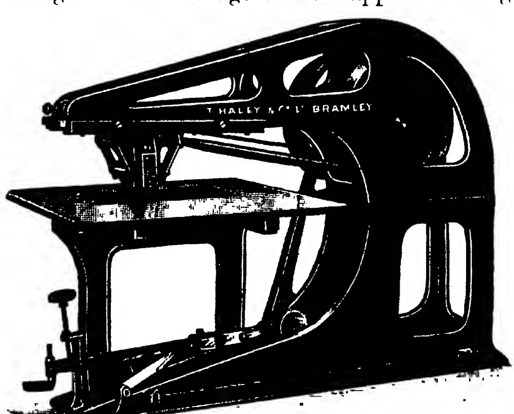


Fig. 166.

of the leather, or it has received a covering of some seasoning mixture, is to give the goods a light rolling by machine. The

roller is usually of brass or gun-metal, and it is fixed either in a hand-jigger, (§792), or in a glassing machine, (§801), or in a machine specially built for such finishing. There are several types of rolling machine in the market; a particular type of which machine is illustrated in Fig. 166, suitable for rolling heavy stained (§560) goods, such as bag hides, portmanteau hides, shoulders, etc.; the same machine fitted with an engraved roller is used for printing (§811).

§830. Ironing.—In the finishing of many kinds of 'plain' finished goods the result is considerably improved if the grain

Fig. 167.

surface has been worked over with a warm smoothing iron ('goose') such as is used by tailors. The action of the warm iron being to flatten the grain and give a perfectly smooth level surface. The operation is carried out exactly in the same manner as when cloth or linen is being manipulated. The skin is laid grain side upwards on a strong table covered with a felt or flannel 'ironing cloth' and

the warm iron, a little pressure being put upon it, is carefully worked over the grain surface. The iron most commonly used is, as just stated, the 'tailor's goose,' and the heating of the 'goose' is effected in a suitable stove. Gas irons however, in which the heat of the iron is maintained by ignited gas in the body itself of the iron whilst in actual working are quite in the order of things; as are also electric irons (these are seen in Fig. 167). The advantage of such irons is that the supply of heat can be so regulated that there is no danger of goods being burned by an iron too hot.

§831. Speaking generally, it is beneficial to iron all leathers of plain finish. The procedure is specially useful in the case of mineral tanned leathers; for example, alum leather, calf kid and ordinary alum kid, dull-finished chrome leathers, etc. Ironing is also practised to a very considerable extent on skivers and calf for hat leathers.

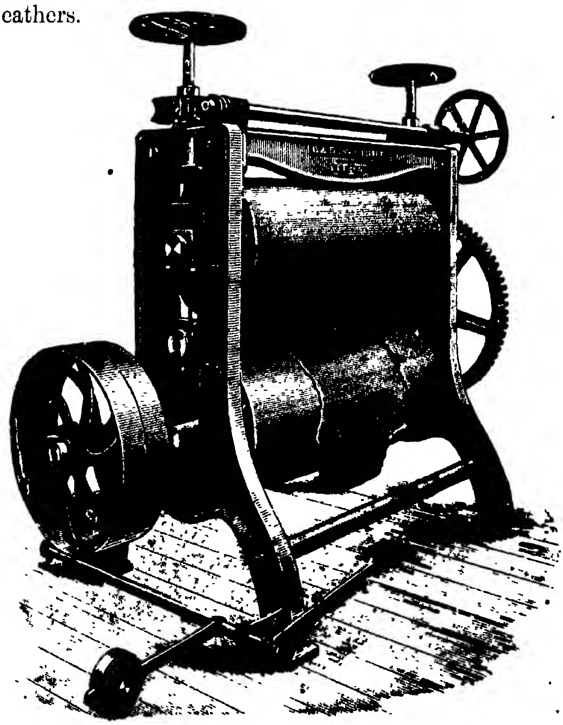


Fig. 168.

§832. CALENDERING.—Calendering consists in subjecting the eather to the action of a heated polished roller, and is somewhat similar in effect to ironing. Calendering by machine, of which a representation is shown in Fig. 168, is now being largely done on calf skins. As will be seen the machine is similar in design to the roller embossing machine, the steam or gas heated roller (the middle roller) being made of polished copper. This operation is also sometimes performed on a rolling machine of similar type to Figs. 156/166, the roller in this case being hollow and heated internally by steam or gas jet.

§833. By using a plain, polished, plate in the machine illustrated in Fig. 162, instead of an embossing plate, the operation of ironing and calendering can be very efficiently performed. The plate is of course heated, either by steam or gas.

CHAPTER XX.

Graining or Boarding.

§834. Graining is the technical term given to the operation by which the natural grain of a skin is so manipulated as to become more pronounced than it would be without the operation.

§835. Graining, or as it is sometimes called 'boarding' is done as follows. The skin to be worked is laid on a slightly sloping

Fig. 169.

table, and is then doubled over, with the grain side of the skin inside. The graining 'board' that the workman uses is usually flat on one side and slightly rounded on the other. The flat side is the top side of the board. A leather strap is attached to the top of the board: the worker gets his working-hold of the board by passing his hand under the strap (see illustration Fig. 169). The rounded under-side of the board is usually cork-faced. The workman, placing nearest to him the fold of the skin, rubs upon it with his board in such way that, by the bite of the cork, he causes the grain surface of the top-fold of the leather, to as it were *roll*, (not slide), over the grain surface of the under-fold. He works thus over the skin with his board, bit by bit from left to right, making use of a stroke away from himself, a pushing stroke, or of a stroke towards himself, a pulling stroke, according as required by the particular work upon which he is engaged. The effect of this treatment is to raise a grain upon the leather, as well as to make it soft and supple. The pressure that the workman puts upon the board varies according to the nature of the goods and the special grain-finish desired. The illustration Fig. 169 is of a grainer at work.

§836. For graining hides and heavy classes of leather, such as Hides, Kips, &c., the graining board represented in Fig. 169 is not suitable, as it does not admit of sufficient pressure being put upon it. For leathers such as the above, an 'arm-board' is necessary. The arm-board is shown in the Plate, facing page 320, in use in the graining of box calf. The grasp of this board should be compared with that of the board shown in Fig. 169. In the case of the arm-board, both the hand and part of the fore-arm are passed under the attached strap, and the board has a handle fixed in it which the workman can firmly grip.

§837. Graining boards vary in size, shape, and working surface according to the work on which they are employed. A graining board used by seal-skin finishers has a hard-board foundation like that of the cork-faced graining board, but instead of cork as a facing, it is faced with a sheet of perforated tin, the face of the board thus resembling that of a household grater for nutmeg,

ginger, suet, &c. This graining board is known as a 'gripper,' and is used only upon seal-skins. The fineness or coarseness of the perforated tin affects considerably the largeness or smallness of the grain that is produced by the tool; the larger the perforations are, the bolder is the resulting grain.

§838. After goods have been 'wet grained' and dried at a high temperature in order to harden the grain (§683) the goods have been rendered somewhat hard, and it therefore becomes necessary to soften them. This is done by working alternately first on the

Fig. 170.

grain side, and then on the flesh side of the skin with the rubber covered hand-board (M, Fig. 146.) When working on the grain side the skin is laid on the table doubled over with the flesh side

of the skin inside. Holding the skin on the table by pressing the leg against a portion of it which overlaps the table, the 'grainer' using a pushing stroke works on the fold of the skin (see Fig. 170). The working on the flesh side is done in a similar manner to ordinary graining (§835).

§839. The face of another graining board used solely by seal-skin finishers is shown in Fig. 146, letter N, (p. 292). It is a hard board, ribbed; and answers the same purpose as a 'gripper.' The face of the ordinary cork-covered graining board is shown in Fig. 146, L. Fig. 146, M shows the face of a graining board which is covered with india-rubber, (see §838). Finishers of shoe-lining leather, East India calf, sheep, Smyrnas, &c., when these goods are to be grained, use a hand graining-board faced with glass or sand-paper.

§840. Graining is one of the most skilled operations in the finishing of leather, and this is especially the case when goat and seal moroccos are being dealt with. It requires years of practice to become thoroughly proficient in the art, for art it really is.

§841. GRAINING TABLES.—The table used in the graining of leather is made with a slope, as mentioned in §835, and the slope is always away from the workman. The slope of the table varies in different finishing-shops and for different classes of work, from about 40° from the horizontal, for use in the production of paste-grains, to about 5° or 10° from the horizontal for graining sumach goat moroccos. The graining table of the calf finisher is generally without slope, horizontal.

§842. The ideal graining table is made of mahogany; should be quite smooth, and polished; and should be quite free of cracks, flaws or imperfections of any kind. Mahogany is expensive, but, with care, a good mahogany table will last for generations. An alternative table, equally efficient, and much cheaper in first cost, though not possessing the wearing qualities of mahogany, consists of a good deal (pine and fir) wood table, upon which is glued a piece of cork-linoleum of good quality, or a piece of cork mat about a quarter-of-an-inch thick, sufficiently large to cover the whole of the top of the table.

§843. Bolsters.—It is customary when graining, to cover the table with a bolster, and to place the skin to be grained on the bolster instead of directly on the table. The bolster is usually a large piece of leather, the flesh-split of a seal-skin being commonly preferred, though a level hide, or a calf-split will very well serve. The purpose of the bolster is to prevent the skin slipping about on the smooth table whilst the work is in progress. When working on a cork-lino table, a bolster is not absolutely necessary, for leather, on the cork-lino, has a better grip than it has upon mahogany. The using a bolster however considerably lengthens the life of a lino-covered table.

§844. For graining moroccos the goods must always be in a specially prepared damp (sammed) condition. After seasoning (§790) and tooth rolling (§796) the skins are placed together in pairs, flesh side to flesh side, drawn through a tank or trough filled with cold water, and then laid over a hurdle and allowed to drain and sam; or else they are brushed over with tepid water and left in pile for several hours, or over-night, as most convenient. The goods are thus, whichever method is adopted, got into the condition referred to as necessary for their graining. The particular direction and manner in which the graining is carried out depends entirely on the particular finish required. If the grained moroccos are for bookbinding and upholstery purposes, the graining, for all glazed finishes, is done in two stages. That is to say, the goods are first grained whilst they are in their sammed condition, they are then dried out and glazed, and after that undergo their second graining. The graining of goods for shoe purposes, such goods as box and willow calf, is invariably done after glazing. Particulars of the more common finishes here follow.

§845. Goats.—Hard-grain goats, after being tooth-rolled (§796) and rendered suitably damp as just described, are grained first across the skin from shank to shank in the two directions, A to B and C to D, as shown in the diagram Fig. 171. They are afterwards worked from belly to belly, and finally grained from neck to butt. This is the usual procedure in every-day finishing, four operations. It is however often necessary to put in a fifth operation, and to go

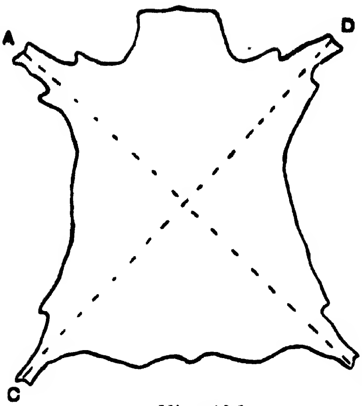


Fig. 171.

round the skin, working inwards from the edges, in this way working the grain up in those parts of the skin which have missed taking up a perfectly round grain.

§846. Another method of working up the grain is as follows: The skin is doubled grain side inside as shown by the dotted line A B Fig. 172, and working on the crease so produced the skin is grained over the whole surface. Doubling the skin parallel with the line C D, (Fig. 172), the graining is now continued in this direction. After the skin has been grained the two ways just described the working up is done in the two directions shown by the lines G H and E F, Fig. 173, the skin being afterwards boarded from belly to belly, neck to butt, and finally round the skin, as mentioned in last section, working from the edges inwards, at no angle in particular, but in whatever direction may be necessary to secure a round grain.

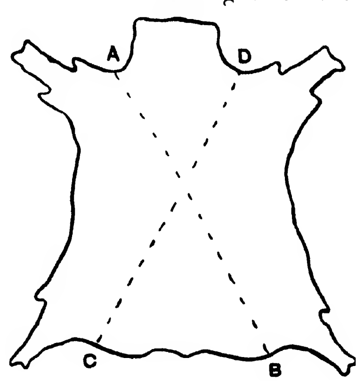


Fig. 172.

When grained the goods are dried, and if not sufficiently deep in colour are 'flamed' with a solution of dye-stuff and dried. If intended for bright finishes the goods are seasoned, glazed and afterwards re-grained by boarding in the same directions as before. Should the goods be required dull they are seasoned and brushed either by machine or hand, afterwards dried out in the stove, being finally softened by boarding with the rubber hand board, (§838).

§847. Straight-Grain Goat.—The goods, after flaming and printing, are dried, and then seasoned and tooth rolled. The tooth-rolling is done in the directions E F, C D, Fig. 174, usually with a No. 7 tooth-roller (§796); the No. 7 tooth-roller is then substituted by a No. 4 roller and the skin rolled across in the direction shewn by the dotted line A B, Fig. 175. After the tooth-rolling the skins are grained straight along the skin

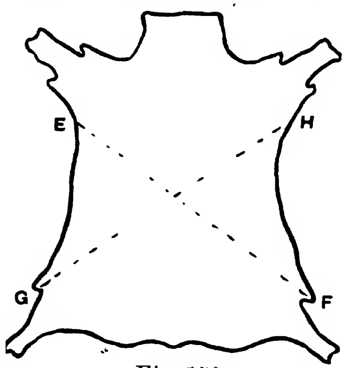


Fig. 173.

A B, from neck to butt, that is (see Fig. 175). They are then dried in the stove, softening by working on the grain with the rubber (§838), and then glazing. The goods are re-grained after glazing.

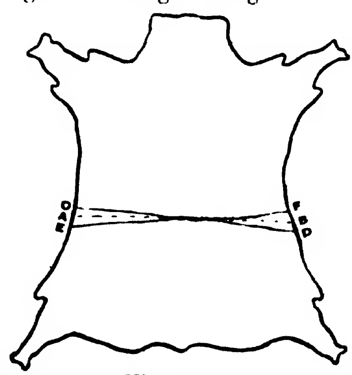


Fig. 174.

§848. Cross-Grain Goats. The goods after being damped (§844) are printed cross grain, afterwards lightly boarded working from shank to opposite shank A to B, C to D, Fig. 171 and dried. When dry the skins are 'flamed' by brushing over with a solution of dye, dried and seasoned, and when in suitable condition are tooth-rolled, using a No. 5 tooth-roller and rolling across the skin from A to B and C to D, Fig. 171. The skins are afterwards glazed if for bright finish, and finally re-grained in the same directions as before.

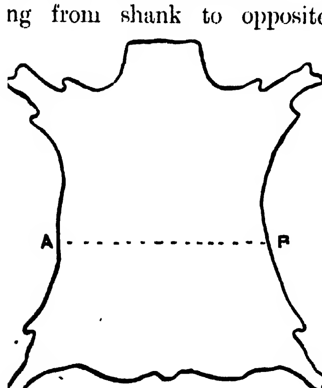


Fig. 175.

§849. Graining by Machine.—As stated above, (§840), graining is an expert operation, an art. So being, the duplication of expert graining is not within the scope of machinery. Nevertheless, say in the case of box and willow calf goods, as an approximation to perfection is all that is necessary, and the excellency that is looked for in hand-dressed moroccos is not indispensable, machine graining finds a suitable place. The best machine for the purpose is the Roller Graining Machine represented in the Figs. 176 and 177.

§850. This machine, originally patented (1873) by W. J. Coogan, was improved by W. Paul in 1885. The leather under treatment is pressed in a doubled state between two cylindrical rollers. The improvement in the machine was to greatly increase the diameter of the cylinders, to make them more than three times

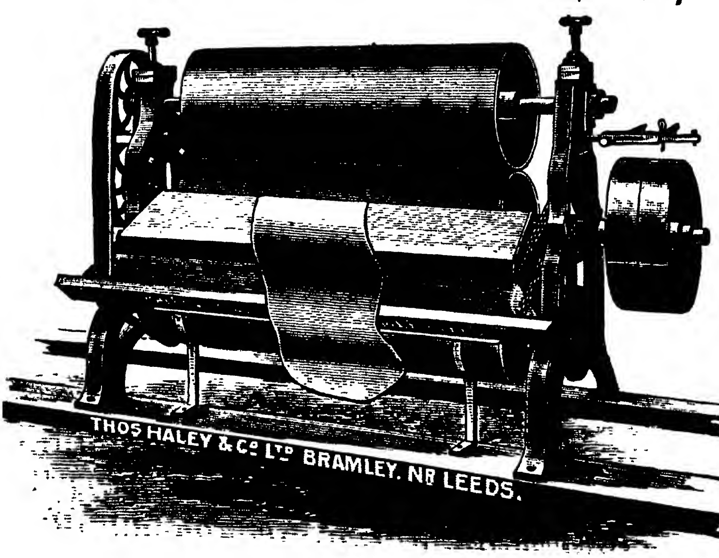


Fig. 176.

as large as they had previously been made, and to cover them with kamptulicon or cork floor-cloth; they had before then been covered with natural cork-blocks. It is claimed for the improved

machine that it grains better and quicker. The machine is extremely simple in its action. The two Figs. 176 and 177 show two different makes of the machine.

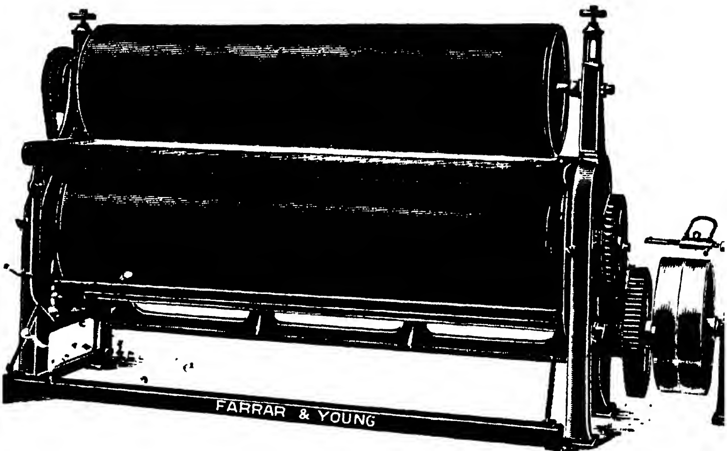


Fig. 177.

§851. The machine, in the main, consists of two rollers (see Figs. 178-180), C and D, of which roller C is the smaller; a swinging table, FG, of which the G portion is of wood, F being a steel plate fixed to it; a treadle J; and a supporting framework. The driving pulleys are on a shaft of their own which runs across the machine; and the two rollers are driven by chain-gear from this shaft, the roller D by gear at the driving-pulleys end of the shaft, and the roller C by gear at the far end of the shaft. The two gears are shown, partly, in Fig. 177. Assuming the side-lines of the framework of the machine to be vertical, as they are in ordinary practice in the case of a machine erected on a horizontal flooring, it will be seen that the centres of the two rollers are not in one and the same vertical line, but that the centre of the

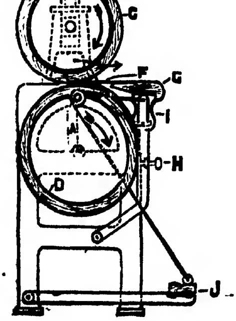


Fig. 178.

Finishing Shop (Box Calf).

To face page 320.

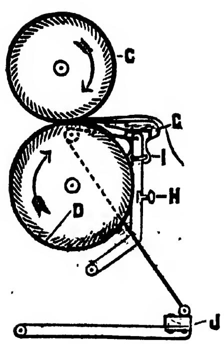


Fig. 179.

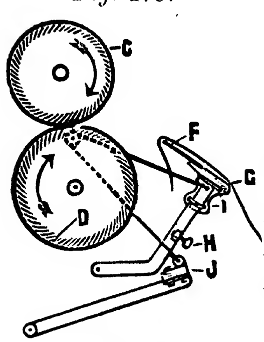


Fig. 180.

roller C is set back somewhat from a vertical line passing through the centre of the roller D. Excepting that the roller D is free to rotate, its position is fixed. But the upper roller C, besides being free to rotate, has motion of adjustment; and supposing the rollers, both, to be running and to be just clearing each other, the upper roller C can be set by screws not seen in the Fig. and the distance between the rollers increased, so as to give room when thick skins are being dealt with. Another adjustment by means of the screws B (Fig. 178), of which there is one in each side-frame, enables the operator to regulate the pressure on a skin that is being worked, according as required to board and soften it. The treadle J, when pushed down by the foot, raises the table FG from the position in which it is seen in Fig. 180 to that represented in Figs. 178 and 179. The connection between the treadle and the table is by means of a cord or chain (see the Figs.), and the table is so balanced as to fall back when the foot is removed from the treadle. The machine has also a means of adjustment of the table on the levers which carry it.

§852. The skin to be grained is laid over the plate F, flesh side uppermost, the adjustment of the table being such that when lifted by means of the treadle (it can also be lifted by hand), the edge of the steel plate is fairly central between the rollers. Very exact adjustment is not necessary, as the plate will regulate itself to the variations of thickness in a skin that is being worked. The skin is laid upon the table as represented in Fig. 180 by the irregular line in the Fig., the loose end of the skin hanging over the table as shown. The lifting of the treadle brings table and skin into the position seen in Figs. 178 and 179, the loose

end being held up on roller D. The arrows in the three Figs. show the direction in which the rollers are revolving; both in the same direction. The rollers being in action and the fold of the skin over the edge of plate F being brought up to the rollers, the roller C takes a bite on the skin, and carries the actual bend or fold of it just beyond the extreme edge of F, so that it is this, the fold, that takes the nip of the rollers. And, as these are in motion, the top ply of the fold is *rolled* upon the bottom ply, exactly as is the case in boarding by hand (§835). With the machine however, there is no return, or pulling, stroke; so that an ever-changing fold of skin is fed continuously forward, and gets a rolling-nip between C and D. The skin, loosening after th[illegible] passed on, by its under ply, over the roller D, and comes to the operator's hands underneath the table.

§853. The movement of the skin, as just above stated, is the same as its movement when hand grained; it *rolls*. The grain that is raised on a skin is in the direction of the length of the machine; the skin that is being worked must therefore be fed to the machine in the reverse direction to that in which it is desired that the grain shall run. In order to thoroughly grain and soften a skin, it is worked over by the machine in several directions. Figs. 171 to 175 show directions in which a skin may be worked; and the skin is passed in each direction through the machine once or twice, as may be, according to the judgment of the operator. When a skin is on the table of the machine and is hanging partly over the plate, the portion that is towards the operator should be held by him with the fingers of his two hands upon it over the round front of the table (the G part of the table), and his thumbs under the table, his hands being kept as far apart as possible. With his hands thus disposed he can arrange the leather, as he brings it up to the rollers, and can keep it straight as it is acted on by them. A little experience will best instruct the operator as to the necessary pressure to apply with the foot so that the leather shall feed freely into the machine, and, on the other hand, not jamb up or wedge. To get the required roll of the leather, a little help by the hand of the operator may at

times be necessary. The shape of a grain on a skin varies according to the way in which the skin is fed up to the rollers. The passing of a skin through the machine takes but a fraction of a minute. With ordinary stock, twenty dozen skins, or more, may be worked in a day.

§854. The speed at which a machine can be worked will depend on its size and on the skill of the operator. For the larger sizes of machine, from 8 ft. to 10 ft., a speed on the driving pulleys of from 65 to 75 revolutions per minute is recommended; the smaller machines, those from 5 ft. to 7 ft., may be worked at from 75 to 85 pulley revolutions per minute. Where the stock that is being worked does not require [illegible] severe nip, a grooved brass rib is placed on the plate, [illegible] edge of the rib takes the place of the edge of the steel [illegible] no further hold for the rib is necessary than is afforded by the groove in it.

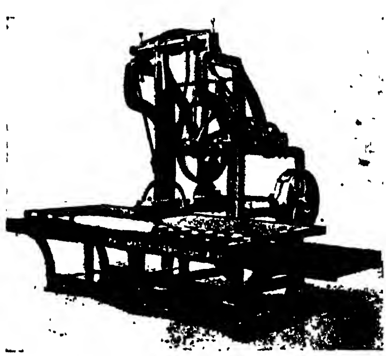


Fig. 181.

§855. Another kind of graining machine, Fig. 181, is designed to imitate the action of the cork arm-board, (§836), as used by hand. This machine is suitable only for the graining and softening of heavy goods, such as heavy calf, light-hides, etc. It is a machine very little known in England, but made use of on the Continent. The action of the machine can be followed from the Fig. The curved 'arm'-board is seen on the table of the machine.

SPONGE MARBLING (§857).

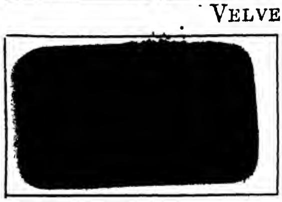
1.—*Stained with*
Safranine G. Extra, (Ber.); [2 ozs. per gallon].
Sponge dabbed with
Jet Black Cryst., (C.); [8 ozs. per gallon].

MARBLED LEATHER (§858).

2.—*Dyed with*
1 oz. Methylene Green B., (By.)
1 oz. Patent Phosphine GG., (S. C. I.)
1 gallon Water.

3.—*Dyed with*
1 oz. Safranine J.E.S., (S. A. D. M. C.)
1 oz. Leather Brown F., (By.)
1 gallon Water.

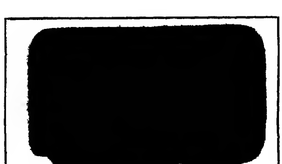
VELVET PERSIAN (§874).



4.—*Dyed with*
2 ozs. Acid Violet 6B., (By.)
2 ozs. Acid Violet 4R., (B.)
4 ozs. Formic Acid
Per dozen skins.

SPRINKLED LEATHER (§861).

5.—*Stained with*
10 ozs. Resorcine Brown, (Ber.);
5 ozs. Azo Flavine RS., (B.)
¼ oz. Acid Green Extra Conc., (C.);
5 gallons Water.



Sprinkled with
(1) Safranine G Extra, (Ber.); [2 ozs. per gallon]
(2) Guinea Green G., (Ber.); [2 ozs. per gallon].

BRONZED LEATHER (§866).

6.—Dyed Black.
Topped with
12 ozs. Magenta, (R. H. & S.)
3 ozs. Safranine T, (B.)
8 ozs. Ruby Shellac.
1 gall. Methylated Spirit.

Finished with
Finish No. 10, Page 282.

CHAPTER XXI.

Novelties and Fancy Leathers.

§856. The present rage for novelty, especially in what are called fancy goods, has caused the fancy-leather manufacturers to be continuously on the alert to produce novelties in leather, which, when made up into one or other of the hundred and one fancy articles made from leather, such as purses and chatelain bags, photograph frames, jewel cases, writing and other albums, etc., will catch the public eye. It will not be possible to here describe more than a few typical methods, by which some of the present day novelty-leathers are produced.

§857. Marbled Leathers.—There are a variety of methods, perhaps better described as 'dodges,' by which a marbled effect can be produced upon leather. The oldest method of producing a mottled or marbling effect, and one which is still practised, is to lay the skin on a flat table, after it has been prepared and struck out as for ordinary dyeing or staining, and to apply the dye solution to the skin by means of a sponge. The sponge, which is only lightly filled with the dye solution, is dabbed over the surface of the leather, and leaves behind in colour on the leather a sort of representation in figure of that portion of the sponge surface that has come into contact with the leather surface. After in this way going over the skin with one colour, the sponge is applied in like fashion to the leather with a dyestuff solution of another colour. Sometimes a third colour is thus applied, sometimes even a fourth. The finished leather presents a varied mottled effect, of which the pattern, No. 1, page 324 is an example.

§858. A more recent and much prettier marble-effect, introduced originally from Austria I believe, is obtained by the

following procedure. The skin, after preparation, and being struck out as tight as possible, is pleated, or puckered up into folds, as shown in the photographic reproduction, Fig. 182. After the pleating, it is well to leave the skin for some hours, as it can then be handled with greater ease, and without destroying the arrangement of the pleats. With the skin thus pleated or puckered it is dyed. The dyeing may be done by placing the skin in a wooden trough or box fitted with a perforated bottom, just sufficiently large to comfortably take it as folded up, and then pouring, from a jug or other convenient vessel, the dye solution over the skin as lying in the trough. After the lapse of a few seconds, the dye should be poured off, and the skin removed, and the skin should be then at once washed and struck out. Because of the folds of the skin, the dye solution is taken up unevenly, (see Figs. 182, 183, and patterns 2 and 3, page 324), but the colour is without harsh lines to offend the eye, the various tints blending softly into each other. Considerable variation in marble effects can be introduced by variation in the pleating, each variation bringing about a different marbling of the skin. A photographic reproduction of a skin after dyeing is shown in Fig. 183.

Fig. 182.

§859. When a pack of skins which are to be of similar marbling has to be dealt with, each skin should have a box of its own, and the boxes and skins should be suspended in a dye-bath, a sort

of lid of copper gauze being fastened on each box to prevent the skin floating out. On removing the boxes from the bath, wash and strike out the skins. The general depth of shade of the skins will of course depend on the length of time they remain in the dye-bath.

§860. A variety of fancy effects are produced upon skins, by heavily embossing (§811) the goods after dyeing them to some particular shade, drying them out as if for finish in the usual manner, and then, after softening the skins by boarding them (§835) on the

Fig. 183.

table, lightly fluffing (§780) the grain surface of the skins so as to remove the high portions of the embossing. The skins may be either left as fluffed and finished in the usual way, or they may

be topped with a solution of dyestuff of another colour, so as to stain those portions of the grain surface that have been considerably lightened in colour or rendered white by the fluffing. Very tasteful effects are thus produced on calf which has been embossed with an alligator or crocodile print, originally dyed a bright green, and afterwards fluffed and topped over with a weak solution of a suitable brown dyestuff mixture; the outcome being to produce a sage or olive green foundation colour on the skin, with a brown effect on the portions of it that have been caught by the fluffing.

§861. SPRINKLED LEATHERS.—There have been put on the market from time to time quite a number of fancy sprinkled-leathers, chiefly for bookbinding purposes. Perhaps the most common of these are sprinkled calf and sprinkled skiver, as these are most in demand by bookbinders. The reason for a demand in sprinkled leathers by bookbinders is evident. To first bind a book completely in plain leather, and then afterwards to sprinkle the cover of the book gives considerably more trouble than to bind the book direct with leather cut from a sprinkled skin. Until the advent of sprinkled leathers however, the procedure mentioned is what the bookbinder had to go through whenever, and this was fairly often, such binding was required.

§862. A skin that is to be sprinkled is usually dyed to a pale shade of brown, and it is sprinkled with a weak solution of ferrous sulphate, (copperas, §444). The skin is laid on a slightly inclined table, and the sprinkling is from a brush, a large painter's sash-tool being a serviceable brush for the purpose. The brush is first dipped into the solution, and then all surplus liquor is well beaten out of it. Holding the brush now over the skin, say with his right hand, the worker strikes it against a stout stick held in his left hand, in this way causing a fine spray of the ferrous solution to fall upon the skin. Continually moving the brush and continuously striking, he gets the spray evenly distributed over the skin, ceasing to strike when the effect is satisfactory to him.

§863. A variety of coloured effects can be produced in this way, employing coal-tar colours and sprinkling with several colours, two, three, or more (see pattern No. 5 of sprinkled leather, page 324).

§864. Another effect produced by the bookbinder on a bound book, that known as 'tree-marbling,' is now to a limited extent brought about by the leather-dresser. The description of the binding of a book as being 'tree calf,' or 'tree-marbled calf' is often to be found in booksellers' catalogues. The leather-dresser first sizes-over with a weak solution of farina or starch the skin that he is working on, and then dries the skin out. Laying the skin on an inclined board, he now lets water fall upon it from a small bundle of twigs that has been dipped into water. The water runs down the leather in small streams, which streams unite as they flow downwards. Solutions previously prepared, one of ferrous sulphate, (8 ozs. per gallon of water), the other of "salts of tartar," (potassium carbonate) 12 ozs. per gallon of water, are now sprinkled over the skin in the manner above described (§862) from brushes dipped into the solutions and then well beaten out. The outcome of the whole procedure is to produce an effect which may be said to bear resemblance to a tree. Immediately that the iron solution has 'struck' the leather, this is well washed with water; the skin, after that, is ready for finishing.

§865. Spanish or Antique Leather.—This is a leather now much in fashion for upholstery and for fancy purposes. Spanish leather,—rightly termed Italian leather, as the original examples of the leather are of Italian and not of Spanish origin,—is usually imitated on split hides. The leather is generally embossed (§811) with a large impress of the grain of elephant hide, or of rhinoceros hide (No. 5. Page 300), and is then coloured in various very sombre shades of different hues by dabbing with a sponge, (§857), a mottled or marbled effect in imitation of antique leather being thus obtained. Various 'tricks' or 'dodges' are resorted to in the production of these leathers to obtain unusual effects. Such for instance, as dusting the leather, stained in say a yellow colour and whilst still damp, with iron filings, then rolling it by machine, (§829), and allowing it to dry, the iron filings being shaken off when the skin is dry, and various weak colour-solutions applied to the leathers by sponge-dabbing or by sprinkling, (§862).

§866. Bronzed Leathers.—Instead of a glazed surface there is a demand for leathers having a metallic-bronze surface, for children's slippers especially, and also for fancy purposes. The bronze effect is brought about by accentuating the natural tendency to bronze, (§320), common to many basic colours.

§867. In order to produce a full bronze effect it is necessary to apply the dyestuff to the leather in a very concentrated solution, dissolving the dye in methylated spirit and then applying the solution to the leather, as in ordinary staining (§564), with a sponge or brush.

§868. Those dyes which have the greatest tendency to bronze when used in ordinary dyeing or staining are of course the dyes chosen to obtain the bronze effect, the more common of such dyes being Magenta and Safranine, which produce a greenish bronze. By using Methyl violet a yellowish-green lustre is obtained. Methylene blue gives a copper-coloured bronze, and Bismark brown a golden bronze. It is advisable in the case of leather that is to be bronzed, to first stain or dye the leather a dark colour. A maroon or a dark blue or violet leather is in fact the most suitable leather to work upon for the bronze effect.

§869. A very strong dye-solution is necessary in order to obtain the desired intensity of bronziness. The bronze that is on the surface of the leather is loose in its very nature, and unless fastened-on somewhat to the leather is easily rubbed off. The fixation of the colour is usually achieved by the addition of shellac to the methylated-spirit mixture.

§870. For bronze effects the following recipes may be taken as typical.

Green Bronze:—	Copper Bronze:—
12 ozs. Magenta.	10 ozs. Methylene Blue.
3 ozs. Safranine.	2 ozs. Bismark Brown.
4 ozs. Ruby Shellac.	4 ozs. Shellac.
1 gallon Methylated Spirit.	1 gallon Methylated Spirit.

The mixtures should each be placed in a bottle and kept in a

warm room until there is complete dissolution, the bottle being occasionally shaken. In order to complete the fixation of the colour, the goods should, as just mentioned, be seasoned with the shellac finish No. 10, (page 282). A pattern of bronzed leather is shown on page 324.*

§871. VELVET LEATHERS.—The old fashioned 'ooze leather' has of late years again become fashionable under another name—"velvet leather." The velvet leather of to-day varies somewhat from the older ooze-leather. This latter leather was almost always exclusively a calf leather finished on the flesh side; the fashionable velvet-leather is made of sheep, goat, and calf, finished on both grain and flesh sides, according to fancy and requirements.

§872. Velvet leather as the name indicates is a leather finished with a 'pile' or nap surface somewhat resembling velvet. The leathers chiefly dressed in this finish are East-India sheep ('Persians'), finished sometimes on the flesh side and sometimes on the grain. Calf and light kips (or 'kip calf') are generally finished on the grain side; hide bellies, shoulders, etc., are finished always on the grain side.

§873. The leathers are chiefly used for fancy leather-goods purposes, pocket books, wallets, purses, chatelaine and ladies hand-bags, etc. The velvet 'Persians' are sometimes used for binding gift books, etc., and the calf and hide finished in this style are also used for ladies' belts, etc. English sheep (Basils) are often finished on the flesh side with a somewhat coarse nap, for leggings, etc. The method of dressing these goods will be understood from a description of the processes employed when the two leathers, velvet sheep and velvet calf are dealt with.

§874. VELVET SHEEP.—As above mentioned (§872) 'Persian' sheep are usually employed when the finish is to be obtained on a sheep skin.* The goods, which should be selected for tightness and closeness of texture on the flesh side and freedom from butcher cuts, are generally shaved on the flesh side. The better plan when stout goods are being worked is to shave them on the grain side. Usually the shaving required is only "necking and backing."

*The pattern No. 4 on page 324 is of velvet Persian.

§875. After shaving, the goods should be placed in the drum for preparation. The preparation necessary consists of a light stripping with borax, 2 ozs. per doz. skins being generally ample at a temperature of 35°-38° C.(95°-100°F.), and drumming the goods 15 to 20 minutes; afterwards the goods are washed up in warm water 45° C. (113° F.) and retanned with sumach (§128) followed by a light fat liquoring (§623). The goods are now removed from the drum, horsed up for a few hours, and are then dried out strained on boards or frames (§§677, 679); the skins being nailed flesh side uppermost.

§876. When dry, the goods are fluffed on the flesh side the fluffing machine, Fig. 143, being largely used for this purpose. The skin should be fluffed twice, once with a medium grade emery, and afterwards with a fine emery, the object being to get as fine a surface or 'nap' as possible.

§877. A fine nap surface having been obtained, the goods after wetting back by soaking in water are ready for dyeing. The dyeing must, if best results are required, be done in the drum; neither the paddle nor the tray methods being so satisfactory when manipulating these goods.

§878. In dyeing, the 'acid' dyestuffs (§330) are to be preferred to the basic colours (§301) for these goods. The colours resulting from the former are not so prone to removal when the finished goods are rubbed, as is the case when the latter dyes are employed.

§879. It will be found necessary, for nap surfaces, to employ a much larger quantity of dyestuff than for ordinary grain finish. For full shades 8 ozs. of dye per dozen skins will generally be required. The addition of formic acid to the dyebath to develop the colour will be found preferable to sulphuric acid on these goods; as, apart from the injurious action of the latter acid (see §331), it will be found that the goods will dry softer, and without the objectionable squeak common to these skins when handled if dyed with sulphuric acid and an acid dyestuff, and not fat-liquored.

§880. The goods after dyeing are well rinsed, struck out, and lightly oiled over on the flesh side with a good quality mineral, or sperm oil, the application being preferably made with a velvet covered pad, and dried strained.

§881. When dry the goods should be softened. This may be done in any desired way, *e.g.*, by machine-staking (§687), by perching (§692), or by boarding-up on the table (§835). After the skins have been softened, they are worked over on the flesh side to raise the 'nap.' This is often done by lightly fluffing on the machine, Fig. 143; using a very fine emery

Fig. 184.

covered or stone wheel. The operation is however best done by 'scurfing' the goods, the skins being placed in the perch (§692). The scurfing is best done by the tool shown in Fig. 185, and in use in Fig. 184. The scurfing tool shown (a design by the author) consists of a block of wood 9 ins. by 2¾ ins., slightly oval on the

under face, where the emery paper is attached, and fitted with a stove-brush handle on the top face. A strip of emery paper, size 10 ins. by 2½ ins., is carefully cut from a sheet of the required fineness, and is fixed in the tool by means of screw clips. Working over the skin on the flesh side with this tool in the manner shown in Fig. 184 the operator carefully raises the nap over the whole surface of the skin. By pressing the tool on the surface of the leather whilst working and by varying the grade of emery paper used, it is possible to obtain a very fine velvet-like nap, without interfering with the colour of the dyed leather; to which there is always a liability when the fluffing is by machine.

§882. After the goods have been fluffed or 'scurfed,' they simply require brushing-over with a fine brush, in order to remove any loose dyed-fibre left on the surface: they are then ready for the market.

§883. VELVET CALF.—When this leather is to be dressed the goods are first wetted down and shaved. After shaving they are scoured on the table with soft soap and borax solution (§§105, 106)

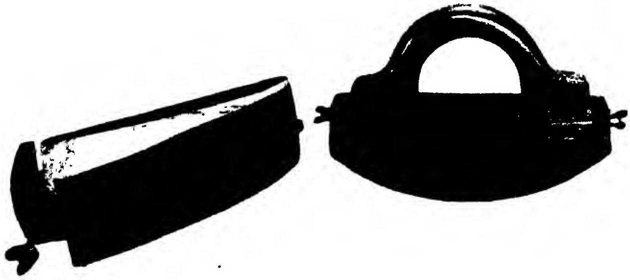


Fig. 185.

and are then sumached in the drum (§128). It is an advantage to give the goods a light fat-liquoring after the sumaching. The wet work having been completed the goods are now hung up to dry. When in a half-dry ('sammed') condition the goods are

well set-out, and the drying is then completed. After drying the goods are buffed on the grain side with a whitening sleeker; the whole of the grain being removed by this process. The buffing operation requires to be very carefully carried out, taking particular notice that the goods are buffed just sufficiently deep to remove the grain, and yet not so deep as to cause the 'nap' to be coarse. Some manufacturers remove the grain by buffing with the shaving knife over the beam (§§64-66), the goods being in the damp condition as for ordinary shaving (§62).

§884. In the case of hide shoulders, bellies, and kips the buffing is generally done by machine. The machines Figs. 139, 141, being generally employed for the purpose. To complete the work of buffing, the goods are further carefully gone over on the grain side with a flat wooden block covered with emery paper. The

Fig. 186.

block shown in the illustration (Fig. 186) is a very useful tool for the purpose. The face of the tool is covered with a piece of sheet india-rubber, emery cloth of the required grade being laid over the india-rubber, and held in place with the fingers (see Fig.) The india-rubber cushion gives the tool sufficient resiliency to prevent any cutting away or scratching of the surface of the leather. The working over of the surface with the emery-covered block completes the production of a fine velvet-like nap.

§885. The goods, possessing now a fine velvet nap, are ready for dyeing or staining. Dyeing is preferable to staining on this class of leather, and is best done in the drum, employing acid dyestuffs (§330). Many of the direct colours (§347) are useful when art shades are required in this class of leather. No particular difficulty will be encountered in the dyeing; the skins being manipulated in exactly the same manner as calf intended for boot uppers.

§886. The skins, having been dyed, are well washed in water and struck out. The application of a little oil to the grain side after the striking out, will help to soften the goods if they have not been previously fat-liquored as recommended (§883). The goods are best dried out strained on boards.

§887. When dry the goods should be softened, by perching (§692) on the flesh side, and the 'nap' afterwards raised by lightly working the grain side with a wooden block covered with very fine emery-paper or sand-paper; the skins being laid on a table covered with a leather-bolster ('slave') during the operation. The object of the 'sand-papering' is to again raise the fine nap which has been laid down by the wetting in the dye bath. Heavy goods are sometimes 'bruised' with a cork-covered arm-board (§836) working on the grain side, to still further soften the goods. After brushing the grain over lightly with a soft brush in order to remove adhering fluff the goods are ready for the market.

CHAPTER XXII.

The Dyeing and Finishing of Chrome Leather.

§888. As regards being difficult to dye, amongst the various kinds of leather, chrome leather undoubtedly occupies premier position.

§889. In fact, so difficult is the operation of dyeing chrome leather, when large numbers of skins have to be dealt with, and the same shades, identically, have to be obtained upon a number of packs of goods dyed at different times, that no manufacturer of chrome leather, either in the United States of America, or in France, Germany, or England, is satisfied wholly, either with his method of dyeing, or with the results he is obtaining; and this *now*, after so many years' experience with this metallic-tanned leather.

§890. In treating the subject of the dyeing of chrome leather, the first point to discuss is the previous preparation of the leather. The dyer generally receives the leather in the wet condition immediately after shaving; it being after the shaving that the goods are usually sorted whether for blacks or colours.

§891. Although the tannage of the skins has been by treatment with a basic salt of chromium, and the salt of chromium which is fixed in the leather is of a basic nature,* the leather immediately after tanning still contains a very material amount of free acid, which acid, if not neutralised, is liable to cause trouble in subsequent processes; and if left in the finished leather, to bring about tenderness of fibre and other serious defects.

§892. The leather moreover, as the dyer receives it, also retains a certain amount of soluble salts, which have to be got rid of.

*See Procter's "Principles of Leather Manufacture," p. 215.

The dyer's first operation therefore, is the removal of the soluble salts and the neutralisation of the acidity. To effect this the goods are subjected to a washing in hot water, which is usually carried out in the drum; the goods being drummed in two changes of water at a temperature of about 50° C. After the washing, they are drummed in a weak solution of an alkaline salt. Borax is almost universally employed for this purpose. Sodium silicate (water glass), and sodium phosphate can also be used for the purpose. The stronger alkalies, sodium carbonate and sodium bicarbonate, also have their uses.

§893. The amounts employed of borax or of the other alkalies necessarily depend on the acidity of the leather; generally about 1 per cent. of borax is sufficient, the percentage being taken upon the weight of the goods, drained drip-dry after tanning. The following are recommended quantities of the other salts:—½% Sodium Bicarbonate, ¾% Sodium Carbonate, 1¼% Sodium Silicate, 1% Sodium Phosphate.

§894. After neutralising, which is best carried out at a temperature of 40° C. (104° F.), the goods should be again washed in water to remove soluble salts. The actual dyeing, and the fat-liquoring, (see Chapter XII, p. 214) now follow.

§895. Some few manufacturers commence work with the operation of fat-liquoring. The more customary order of procedure however is to do the dyeing first and make the fat-liquoring the subsequent operation.

§896. Contrary to what might be expected, chrome leather has but little affinity for acid (§330) or basic (§301) coal-tar colouring matters. Hence, previous to the dyeing, it is usual to treat the leather with a 'tannin mordant,' consisting of a solution of some vegetable substance or dyewood that is easily absorbed by the leather. The effect of this treatment is to render the leather capable of fixing the artificial colouring matter. The treatment with the tannin solution also, to a considerable extent, assists in the later operations of glazing and finishing.

§897. In making choice of the vegetable tanning or colouring matter just referred to, care must be taken, whenever possible,

to employ only such material as contains but little tannin. The effect upon chrome leather of a too strong solution of tannin is to reduce the stretch of the leather, to tighten the grain and make it more prominent; if the solution is very strong, the effect of treating the leather with it is to impair the strength of the leather.

§898. The vegetable substances most commonly employed are :—

Logwood Extract (see §390), which produces in weak solution a dark violet-purple shade.

Fustic Extract (see §407), which produces in weak solution a greenish-yellow shade.

Hemlock Extract, which produces in weak solution a slightly reddish-drab shade.

Sumach Extract, which produces in weak solution a greyish-white or very pale greenish-yellow shade.

Gambier, which produces in weak solution a brownish-yellow shade.

Palmetto Extract, which produces in weak solution a shade somewhat similar to that produced by hemlock.

Peachwood Extract (§410), which produces in weak solution a bluish-red or claret shade.

Sumach, owing to the very pale shade obtained, is a favourite mordant for use when the goods are to be subsequently dyed in pale or fancy colours. Sumach extract is more convenient to use than the powdered sumach leaf for this purpose, and usually gives a much lighter-coloured bottom to the leather. When solid sumach is used, it is recommended to extract the material first by pouring water at a temperature of 60°-70° C. (140°-158° F.) on the sumach, allowing to stand for some few hours, and afterwards separating the solid particles of sumach by filtering off the liquor through a piece of clean bagging or canvas; the clear liquor being used for the mordanting. Gambier and fustic extract in admixture are mostly favoured for use as a mordant when the goods are to be dyed shades of brown. Hemlock extract is principally useful when ivory and drab shades are to be dyed, the

leather in this case being very often dried and finished without colouring with coal-tar dyestuffs. Peachwood extract is the most useful mordant when "ox-blood," chocolate, or dark red shades are to be dyed.

§899. Most other vegetable tannins and dyewoods are unsuitable, because of their want of affinity for the leather. Logwood, fustic, and peachwood, on account of their containing little tannin, may be used with fair freedom; these dyewood extracts, all of them, if not used in great excess, do no appreciable damage. When employing gambier, palmetto, hemlock, and sumach, it is necessary to take special care, the percentage of tannin being large in these materials.

§900. Many of the above materials are used in combination one with another to produce different bottom colours on the leather, according to the colour eventually required. The quantity employed of the vegetable extract necessarily varies according to the result to be obtained, but whenever possible it should not exceed 2 per cent. on the drained weight of the wet goods.

§901. When greasy skins are being treated, it is usual before mordanting to drum or paddle the goods in a weak solution of lactic, formic, or acetic acid. The acid solution is prepared by diluting half-gallon of lactic acid, or one quart of formic or acetic acid with 50 gallons water.

§902. Just as with the removal of the soluble salts and the neutralisation of acidity (§§892-894), the application of the tannin mordant is carried out in the drum, the operation being performed at a temperature of about from 50° to 55° C., and in the solution at this temperature the goods are tumbled for from twenty minutes to half-an-hour.

§903. The dyeing of coloured chrome-leathers, in the United States, France, and Germany, is almost exclusively done with the basic colours, and the tannin mordant is then fixed by treatment with a solution of tartar emetic, (see §§473, 474), previous to the dyeing. The usual method of procedure is to add the tartar emetic solution to the contents of the drum after the goods have been drummed for a sufficient length of time in the tannin mordant. The

quantity of tartar emetic usually employed is two ounces per dozen goat skins and four ounces per dozen calf skins.

§904. A certain amount of the tartar emetic, being precipitated by the tannin still remaining in the bath, is of course, wasted, but the loss is generally considered to cost less than the extra labour and time required in the preparation of a fresh liquor and the transference of the goods. The tartar-emetic solution can be recommended when pale shades of grey, drab, ivory, &c., also blues, are to be dyed; but when shades of brown, red, &c., are to be produced, then there can be substituted with advantage for the tartar-emetic solution, one or other of the salts of titanium, (§455), either potassium titanium oxalate, tanno titanium oxalate, or titanium lactate.

§905. The effect as regards colour, of treating with a titanium salt a chrome leather that has been mordanted with one of the above tannins (gambier, palmetto, sumach, hemlock, &c.), is the production of a bright yellow tan-shade, in addition to the fixing the tannin in an insoluble form in the fibres of the leather, and, by the fixing, preventing the tannin precipitating the dye in the dye-bath when the leather comes to be dyed with the basic colours (see §301). The yellow colour so obtained reduces considerably the amount of dye-stuff necessary to produce the required shades as well as furnishes a shade which is extremely fast to light. The effect of treating with a titanium salt a leather which has been dyed with logwood, is to change the violet-purple colour to a greyish shade of black, and the effect of treating with such salt a leather that has been dyed with peachwood is to change its bluish-red shade to a dull yellowish-red.

§906. Another method of applying the salts of titanium, especially when acid or mordant colours are employed in the dyeing, is to dye the goods first in a solution of a suitable coal-tar dye in admixture with the solution of fustic, gambier, or other tannin mordant, to afterwards run the excess of dye-bath away, and then to proceed to treat the goods with the solution of the titanium salt. When pale shades of colour are particularly required, chrome leather may be dyed direct without any intermediate mordanting.

Many of the direct cotton colours (§347) are particularly suitable for this purpose.

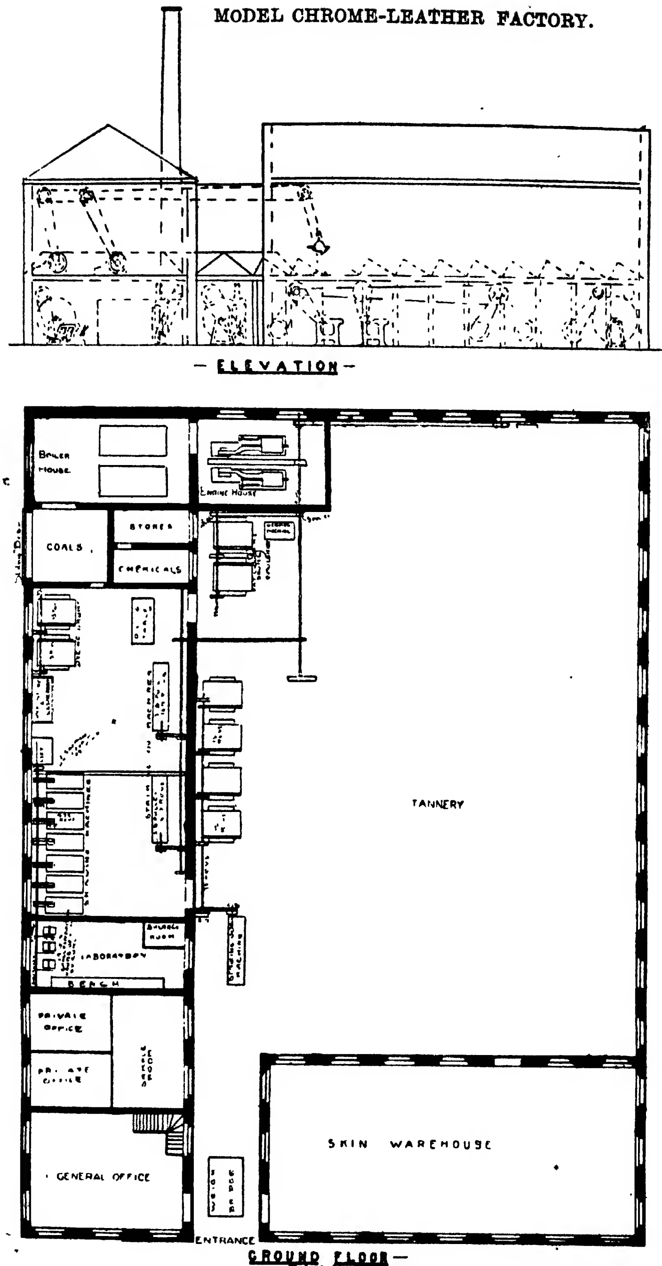
§907. The *dyeing* operation is invariably performed in the drum, this being practically the only method of application that gives results which approximate to being satisfactory. The goods after fixing, (if this operation has been performed; the operation being, of course, optional when dyes which are unaffected by tannin, *i.e.* acid and direct colours, are employed), should be well washed; they are then ready for the application of the dye. The dyeing should be performed at a temperature of about 60° C., (140° F.), and at least three-quarters of an hour's drumming will be necessary to secure a full shade of colour, the dissolved dye being gradually added through the hollow axle of the vessel as the drumming proceeds. When dyed, the goods are ready for the fat-liquoring treatment. (See Chapter XII, p. 214.)

§908. The fat-liquor, which is necessary in order to 'feed and nourish the leather,' that is to lubricate its fibres, and so produce a leather which is full and soft, is generally added to the exhausted dye-bath whilst the goods are still in the drum, the drumming being then continued for half-an-hour or so, until the whole of the oil-emulsion has been absorbed by the goods.

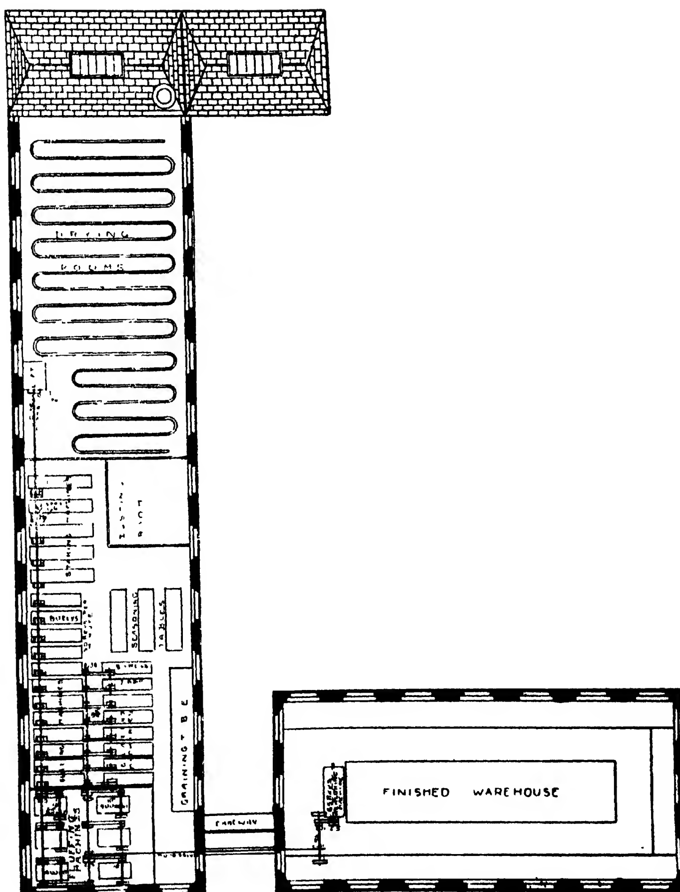
§909. Fat-liquoring is the bugbear of the chrome-leather dyer, principally on account of the fact that the chief fat-liquors employed are alkaline, or contain material amounts of soap; and the action of such fat-liquors is, in the majority of cases, to affect to a very considerable extent the colour of the dyed goods, especially so when the ordinary acid or basic colours have been employed in the dyeing; all this conducing to the eventuality of different shades of colour being produced upon two packs of goods dyed with the same dyestuff but at different times.

§910. Thus, evidently, for the chrome-leather dyer, a fat-liquor that neither contains free alkali nor soap is much to be wished for. The latter ingredient is added to a fat-liquor for the purpose of assisting in the production of a good emulsion. The soap addition is always objectionable in connection with chrome leather, not

MODEL CHROME-LEATHER FACTORY.



Chrome-Leather Factory. Ground Floor Plan and Elevation.



Chrome-Leather Factory. First Floor Plan.

altogether because of its having a detrimental effect in the direction of stripping the colour, but because its effect on the leather itself is oftentimes injurious; too much soap in the leather tending to the formation of an objectionable white spue upon the grain surface of the leather, when the finished leather is kept in stock for any length of time. Further, too much soap in the leather imparts to it a flat heavy feel in place of the soft pliable feel that it ought to have; the fibres of the leather becoming cemented together by the soap. A further practical difficulty with a soap and oil emulsion such as now referred to, is the production of a chrome soap, which is insoluble and which it is impossible to remove, the goods being thus damaged beyond repair. In the case of a fat-liquor prepared of oil only, even when goods are over fat-liquored, the damage may be remedied, by resorting to the ordinary degreasing process by means of benzene or other solvent.

§911. A solution of egg-yolk, which is in itself an emulsion, may be used for fat-liquoring without the colour of the skins being affected. In the majority of cases, however, the employment of egg-yolk without addition of oil or other material is inadvisable, in that it brings about, especially when glacé goats or sheep are being treated, a leather that is too soft for modern requirements. Egg-yolk, moreover, is in England too expensive to permit of its use in quantity upon any leathers except those of the finest quality.

§912. Olive, or neatsfoot oil, emulsified with egg-yolk without any soap addition, makes perhaps the best fat-liquor that can be used on coloured chrome goods. A suitable quantity to use is one gallon neatsfoot or olive oil and half-gallon of egg-yolk for 400 lbs. weight of struck-out leather.

§913. In the production of black chrome-leathers, it is almost universal to first dye the flesh side of the skins a blue or violet colour, by giving the goods a drumming in a weak solution of some suitable coal-tar blue, violet or black; for example, Methyl Violet, Acid Violet, Methylene Blue, Nigrosine, Chrome Black, etc., the goods being afterwards blacked on the grain by either brushing over with the decoction of an extract of logwood-fustic (§898-900), and

then brushing with a weak iron solution, or by passing the skins through small trays or vats containing the solutions mentioned, the skins being either paired together flesh to flesh, or doubled (pleated) down the ridge so that their flesh sides may not come into contact with the dyewood and iron solutions.

§914. Three lbs. of ferrous sulphate (copperas), and a ½-lb. of copper sulphate, dissolved and placed in 30 gallons of cold water, will make a solution through which about eight dozen goat skins or five dozen calf skins may be drawn, without needing to further strengthen the solution. The skins should be well washed in hot water immediately after passing through the iron solution.

§915. A plan which is sometimes adopted is to drum-dye the skins in an acid blue or violet solution, along with which the extract-solution of logwood and fustic is mixed up, in order to colour the flesh side of the skins a bluish or violet black. The goods are after pleating passed through the iron solution in order to strike the grain-side black. Still another method, used principally by glacé-kid dressers, is to omit the blue-blacking of the flesh sides with aniline colour, and to dye the goods direct in a warm solution of logwood and fustic extract, then to run off the greater portion of the liquor, retaining only about a quarter of it, and then to add the iron solution; drumming the goods now again for a few minutes, and after that running the liquor to waste and well washing the leather in hot water.

§916. The iron solution is usually either a weak solution of nitrate of iron, or ferrous-sulphate, together with a small proportion of copper sulphate (§471) or copper acetate. A little potassium bichromate is sometimes added with the idea of accentuating the black to be eventually produced. This latter solution however is not to be recommended; it tends to tighten up the grain of the leather. Even if used in comparatively small quantity the direction of its action is oftentimes to seriously tender the fibres of the leather.

§917. In the case of chrome-leathers dyed black, the blackness can be greatly accentuated by the passage of the goods through a weak solution of titanium salt (§904), either previously to, or after

applying the iron solution, or by adding the titanium solution to the contents of the drum after the treatment of the goods with the logwood-fustic solution, and then drumming the goods for from 5 to 10 minutes, before employing the iron solution.

§918. The using a too strong decoction of the logwood and fustic extract should always be avoided (§897), its tendency being to tighten up the leather, and make it spongy, as well as to impart an objectionable vegetable-tanned feel to the goods.

§919. The use of an alkaline fat-liquor upon chrome-leather dyed black with logwood and iron, is of course not a disadvantage though even in this case the liquor should not be excessively alkaline, nor should the soap it contains be in too great quantity. In respect of the soap, the use of a neutral potash-soap (soft soap) is to be recommended.

§920. The number of coal-tar colours that may be successfully employed for dyeing blacks on chrome leathers is not great, nor are they employed to any very considerable extent upon the better-class leathers that are to be finished glazed, except indeed for the purpose of topping after dyeing in order to accentuate the black or as an addition to the logwood and fustic solution. Goods dyed without the use of logwood do not when finished compare in depth of colour, feel, or finish with those logwood-dyed.

§921. Chrome leather manufacture, speaking generally, differs from all other leather manufacture, in that, ordinarily, it is practically impossible to wet the leather back, if once dried. Because of this, it is customary to keep the goods wet until the whole of the operations upon it, up to and including the dyeing and fat-liquoring, have been performed.

§922. It will be obvious to practical men, that there would be many advantages if chrome leather could be so treated as to allow it to be dried and kept, as are other leathers, in the dry shrivelled condition that is known in vegetable-tanned leathers as the 'crust' (§2). If this could be done, it would then be possible to stock the goods for some short time and to dye and finish them when required. If in such state too, the skins could be more

easily sorted up according to their suitability for particular colours and particular finishes.

§923. The following is a method of so treating chrome leather that it may be dried out and kept in the "crust condition" for any reasonable length of time; the skins being simply damped down by drumming in water when required for dyeing. 'Crust' chrome-leather is not, up to the present, a market article; the manufacturers who tan chrome leather, themselves dyeing and finishing it; and not as is ordinarily the case with vegetable-tanned leather, the tanner then usually selling the goods in 'crust condition,' the dyeing and finishing being done by the leather dresser.

§924. Chrome-leather in 'crust condition' is thus prepared. The goods are first of all neutralised and washed; they are next struck out, preferably by machine (§588). This done, the goods are placed in the drum, which has been made ready with, for every 100 lbs. weight of leather, 15 lbs. common salt, 5 lbs. sodium sulphate (Glaubers Salt), 2 lbs. glucose, and 2 lbs. glycerine, dissolved in 10 gallons hot water. The goods are placed in this solution at a temperature of 40° C. (104° F.), and are tumbled in it for one hour; they are then removed, and without any washing, are horsed up to drain. After the skins have been drained drip-dry, they are hung up in the warm stove and dried out.

§925. The goods as now dried are in 'crust' condition. When the goods are to be dyed, they are placed dry in the drum, a little water is added at a temperature of 75° C. (167° F.), and the goods are drummed for a few minutes. After removal from the drum, the goods are horsed-up for a while in order that the damping they have received in the drum may become equalised throughout; they are then in proper condition for shaving. After shaving, the goods should be drummed in two changes of hot water to remove the soluble salts from them; after this they are ready for dyeing.

§926. The shaving may of course be performed at another stage, that is to say, after the final fat-liquoring, but it will generally be found convenient to perform the operation at this point.

§927. The fat-liquoring is carried out in the drum, which undergoes a previous heating as before described (§§624, 625). If the goods are to be dyed black, the dyestuff used for the blue-backing (§913) may be added to the fat-liquor, if an 'acid' dyestuff is employed.

§928. When removed from the fat-liquor, the goods should be horsed-up for one hour, dipped in hot water, (temperature 60° C.), and struck out; then after that they should be glycerined, oiled, and dried.

§929. The striking-out is generally done by machine (§591), especially in the case of goat and sheep. To glycerine the goods, a light coating of glycerine and water, in the proportion of one part of glycerine to four parts of water, is applied to the grain side of the leather with a brush or sponge. The effect of the glycerine application is to give the goods a mellow feeling. The goods are now commonly struck out again on the machine and after that are oiled over. Black goods are lightly oiled over on the grain side with, usually, neatsfoot oil, applied warm. In the case of coloured goods, the oiling is best omitted, as being quite unnecessary if the fat-liquoring has been properly performed.

§930. The procedure that now follows is the drying of the goods. Goat skins are mostly hung over poles to dry. Calf skins and kips are hung up by the shanks to dry. Skins however which will not lie quite flat, but have a hump near the shoulder, such as kips and large calf, are strained (§677) in order to dry. For the drying of sheep skins the usual method is to strain them on boards or frames.

§931. When the skins are dry, they are 'dusted down' by packing them in damp sawdust (§685), so as to damp them sufficiently for the further operation of staking (§684). The goods are generally left in contact with the damp sawdust for from 24 to 48 hours, sometimes even longer than that, the goods apparently becoming softer and mellower by being allowed to lie in this slightly damp condition. After removal from the sawdust, the goods should be placed in pile for from 24 to 48 hours, the

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wood and iron. Recipes 3 and 4, p. 281, give good results. A small quantity of glycerine added to the finish is an improvement, giving a mellow feel to the grain. A suitable quantity is about 5 ozs. of glycerine to 5 gallons of finish.

§937. For coloured goods the seasoning consists of a weak solution of albumen, milk, and glycerine, the following being the several quantities of the ingredients:—10 ozs. egg albumen; 5 pints milk; 5 ozs. glycerine, made up to 5 gallons with water.

§938. The seasoning mixture requires to be well rubbed into the grain of the leather. Particularly is this necessary in the case of blacks; goods indifferently seasoned having oftentimes an objectionable grey bottom.

§939. After the seasoning the goods are hung up, and the glazing is done when the goods are "in season," *i.e.*, when the thumb nail can be rubbed over the grain side without meeting with any resistance. After the application of the acid solution to the leather, the goods should be wiped over on the grain side with a dry flannel-pad. Glazing the goods immediately after their removal from the drying-stove, and carrying out the operation in a warm room so as to keep the goods warm, facilitates the production of a bright clear finish.

§940. After a first glazing, the goods are re-seasoned, the glazing mixture being used at about half its original strength, and the drying-out and glazing operations are then repeated. Glacé goats and sheep if they have been dyed in colours require no further treatment. Black goods are rubbed over with a cloth or flannel pad slightly damp with warm oil; the oil generally made use of being either sperm oil or mineral oil. The oiling increases the intensity of the black, gives the goods the much desired soft, kindly feel, and at the same time helps the leather to stand moisture and handling without the finish becoming dulled.

§941. Box and willow calf are grained after the final glazing, the graining being usually by machine (§849). The illustration on page 312 shows the graining by hand of this class of goods. When a fine grain is required it is an advantage to grain the goods

before glazing, whilst they are still a little damp with season, that is, and to dry out and glaze afterwards, re-graining after the final glazing. With such procedure, the grain will be found to 'break' very much finer than when the goods have not been previously boarded.

§942. Glacé kids, after the final glazing, are lightly perched or fluffed on the flesh side; the machine illustrated on page 287 being generally employed, and are polished on the grain side with a velvet or plush covered wheel. This latter wheel is similar to a fluffing wheel Fig. 138 (p. 284) the emery being replaced by the velvet or plush covering. This 'wheeling' gives a nice 'handle' to the goods.

§943. Sheep skins that are dyed pale shades of colour, for shoe linings, slipper linings, etc., are usually finished plain. The goods, after being staked, are dried and fluffed, seasoned with a plain season, lightly rolled and dried out, and finally dusted over with French chalk, and brushed. The treatment with French chalk gives a nice soft feel to the grain of the goods. The French chalk is sometimes applied in the drum; the goods being drummed for half an hour in a dry drum with the French chalk addition.

CHAPTER XXIII.

The Dressing of Combination-Chrome Leather.

§944. One of the latter-day introductions into the variety of leathers that are in the market, is that of combination-chrome leather, or 'semi-chrome' leather as it may be called. It possesses to a very appreciable extent the characteristics of ordinary chrome-leather while still largely retaining those of leather of vegetable tannage.

§945. To produce combination-chrome leather, vegetable-tanned leather is treated with a solution of chromium sulphate or chromium chloride, previously rendered 'basic' as it is termed, by the addition to it of a suitable quantity of ordinary washing-soda. By this treatment a soft and pliable leather is produced, which has a feel much resembling that of pure chrome-tanned leather; and if the chrome re-tannage has been sufficient, the produced leather will stand immersion in boiling water without material detriment, just as is the case with actual chrome-tanned leather. It is claimed for this combination-chrome product that it is much more comfortable in wear for boot uppers than actual chrome-leather is; as well as that its wearing powers are considerably greater than those possessed by the ordinary vegetable-tanned leather.

§946. The first operation in the dressing of leathers that are to be combination-chromed, after the operations of sorting (§2), shaving (§62), and scouring (§104) in the case of heavily bloomed goods, have been gone through, is the stripping (§136). In the matter of these leathers, stripping is the removal from them of a considerable portion of the vegetable tanning-matter that they contain, and its removal especially from the grain-surface of the leathers. And the more the vegetable tanning-

matter is removed by the stripping, the closer will the subsequent leathers approximate to a pure chrome-tannage. By careful manipulation in the direction indicated, it is possible to carry the stripping, if it were requisite to do so, to such a point as to leave the goods in a comparatively untanned or pelty condition.

§947. The stripping is best carried out with ordinary washing-soda (see §133), or with "crystal soda,"* the drum being made use of for the purpose. The temperature of the stripping solution is of the utmost importance, especially when considerable quantities of alkali are being employed in order to remove from the goods all (judiciously) possible of the tanning matter in them. The author has found it possible, provided the temperature of the solution does not exceed 35°C. (95°F.), to use, without any risk of injury to the goods, solutions of such strength as would irretrievably have ruined the goods if the temperature of the solutions had been 45°C. The working rule should be that the temperature of the solution during the operation of stripping should never exceed that of the water which the skins if untanned, the pelts that is to say, would stand without injury—a temperature of from 35° to 38°C. (95° to 100°F.)

§948. The extent to which the stripping should be carried depends necessarily on the class of goods that is being dressed, and the ultimate purpose of the goods. An East India sheep or goat, for example, that is to be dressed for glacé, should be stripped to a much greater extent than a bark-tanned calf intended for willow or for box-calf.

§949. The advisable quantity of washing-soda for use in stripping Persians, whether sheep or goat, is about 3-4 ozs. per dozen skins; or, larger dimensions, 3 lbs. per 100 lbs. weight of dry leather. In the case of East India kips or calf the amount made use of should not exceed 2½ lbs. of soda per 100 lbs. weight of dry leather.

§950. The goods after stripping should be well washed with

* Sodium Sesqui-Carbonate (Brunner, Mond & Co.).

tepid water, in the drum. Much of the tannin that has been dissolved by the soda solution still remains in the leather, and is only removed when the goods are drummed. This soluble sodium-tannate, if not removed by washing, will be rendered insoluble by the succeeding operation of treating the goods with the chrome solution, and the very object of the stripping will be in part defeated.

§951. When combination glacés are being dressed, it is advisable to drum the goods in water at 35°C. (95°F.), making several changes of water until the wash-water remains practically colourless. Insufficient attention to the washing process is almost sure to bring about a leather of heavy feel, a leather which lacks the plump, springy, soft feel of the genuine glacé which it is purposed as far as possible to imitate.

§952. The retanning of the goods with the chrome-salt solution follows the stripping. The chrome liquors made use of are similar, necessarily similar, to those of actual chrome tannage, when the latter is carried through by what is now commonly known as the 'single-bath' process.

§953. The chrome solution is best prepared by making a basic solution of chrome alum (potassium chromium sulphate). A suitable liquor is made by, first, dissolving 12 lbs. of chrome alum in hot water and then boiling the solution. Following on this, 2 lbs. of washing soda separately dissolved is added to the chrome solution, the mixed solutions are allowed to cool, and then finally made up to 6 gallons with water. This liquor will be the stock-liquor, and it will be sufficient for the retannage of from 150 lbs. to 200 lbs. of leather. The more chroming the goods get the better will be the resulting leather.

§954. Of preference the retannage should be in the drum; although the paddle method may be chosen, according to circumstances. If the operator has a mind to retan and dye his goods at one and the same time, he may add to the chrome-alum solution a solution of a suitable dyestuff. In the case of blacks, a little Nigrosine (p. 133) or Napthylamine Black (p. 133) may be added to the liquor, or, if the goods are to be dyed brown,

a little yellow dye, or a little potassium titanium oxalate (§455); so as to colour the goods a good bottom colour along with the retannage.

§955. The retannage proceeds in this way. The goods are placed in the drum with a sufficiency of water, one-third of the stock-liquor is added, and in this chrome liquor the goods are run for a quarter of an hour. A further one-third of the stock-liquor is then put in the drum, and in this liquor the goods are drummed for half-an-hour. The final one-third of the stock-liquor is now added, and the drumming is continued for three-quarters of an hour. In all, that is, the goods undergo the drumming for an hour and a half. The penetration of the chrome solution is facilitated if the retanning is done at a temperature of 35°-45°C., (95°-113°F.) The chrome retannage should be thorough, whether calf, sheep, goat, or hides are being dealt with. To test the retannage, a small piece is cut from one of the skins, and is then dried and placed in boiling water. If the piece stands the test without being materially harmed, the retannage of the goods is sufficient; if however the small piece is markedly impaired, the retannage is not sufficient, and the goods should be further drummed, a little more chrome solution being prepared and run into the drum.

§956. After the goods have been thoroughly retanned, they are laid in pile on a horse for one or two days, and are left to 'feed' a little, the goods improving considerably thereby. They are then washed by drumming in water at 50°C., boraxed by drumming in a weak solution of borax, ½ to 1% on the wet weight of the leather, and afterwards washed free from any excess of borax.

§957. When the goods leave the drum after a drumming of half-an-hour in the borax solution the waste liquor should be alkaline, for if any acid is left in the goods there will be trouble in the subsequent fat-liquoring. After boraxing, the goods may be struck out and shaved, and if they have not been dyed in the retannage and are for blacks, they are ready for being dyed a blue back. If the goods are to be dyed right through, it is

necessary to drum them in as small a quantity of liquor as possible, the idea being to as it were throw the liquor against the goods and, so to speak, knock or beat the dye into them. The addition of a little neutral potassium chromate helps the penetration of the dye. The quantity of dye necessary is about 4 ozs. to the dozen skins for goat and sheep, and 8 ozs. to the dozen for calf, drumming at a temperature of 60°C. Alkali Blue (p. 132) may be used if desired, as this has a special tendency to penetrate the goods, and is applied in an alkaline solution. In this case the goods may be first drummed in the weakly-alkaline solution of the dye, and the colour subsequently developed by treatment in a weak acid solution; but the dye is best applied when boraxing, the addition of the dye solution being made towards the latter end of the boraxing operation; the acid liberated during the 'chroming' being sufficient to develop the colour.

§958. The blue-backing operation being completed, the goods may be fat-liquored straightaway, or, if thought fit, the goods may be blacked and then fat-liquored after that. Generally it is the former of these courses that should be fixed upon, the greater part of the dye liquor in the drum being preferably run to waste, and the fat-liquor being added to the remaining spent dye-liquor. The drumming in the fat-liquor emulsion should be maintained for from half-an-hour to three-quarters of an hour. For particulars of fat-liquors and fat-liquoring see §§601, 908.

§959. After the fat-liquoring, and after having been laid over a horse, there left for a few hours, and then struck out, the goods are ready for the blacking operation, which should now follow. Small skins, such as Persians, basils, etc., are best blacked by being first drawn through a solution of logwood and fustic extract, and then through a solution of iron. A suitable strength for the former of these solutions is secured by dissolving 10 lbs. of logwood extract and 2 lbs. of fustic extract in 30 gallons of water. The temperature, for use, of the solution should be 50°C., and the skins, a pair at a time, should be drawn through this solution. Afterwards the skins should be passed through an iron solution, cold, made up of 3 lbs. of ferrous sulphate (copperas), and half a

pound of copper sulphate (blue vitriol), in 20 gallons of water; and finally they should be well washed in water in order to free them from excess of iron.

§960. A customary plan when dealing with small skins is, after boraxing, to dye the goods in the drum with logwood extract, (to which a small addition of fustic extract may be made with advantage, see §409), and a coal-tar dyestuff. Suitable amounts are, for each 100 lbs. weight of leather, 3 lbs. logwood extract, 1 lb. dyestuff. If a basic coal-tar black, *e.g.*, leather black (p. 125) is used, the dyestuff is added in the drum, after dyeing in the logwood extract for three-quarters of an hour. Many of the direct dyes (§347) are suitable for use; these may be added to the logwood extract at the commencement of the dyeing operation. After dyeing in the logwood and fustic (or coal-tar dyestuff, see §409) mixture for one hour, an addition of an iron salt is made, and the drumming prolonged for a further period of five minutes; a suitable amount to use is ½ lb. copperas (§444) per 100 lbs. leather. The goods after this treatment are well washed in the drum with hot water.

§961. After the washing the goods should be struck-out on flesh and grain, sponged over with glycerine and water, and hung up by the hind shanks to dry. When dry, they should be damped down in sawdust (§685), staked (§684), and seasoned (§779, No. 3).

§962. To dry the skins many manufacturers strain them on boards or frames, and are satisfied to soften them sufficiently by perching (§692). A good plan when a grain of fine feel is required, is to dry the goods hung up by the shanks, damp them down in sawdust, and stake them while in the damp condition, and then strain and dry them right out, following the procedure recommended for glacé kids (§§931, 935); afterwards seasoning and glazing the goods, and perching them between the glazings. The goods are finally oiled over with a very slight amount of warm linseed oil.

§963. In the case of heavier leathers, such as kips, kip shoulders, etc., the goods, after blue-backing and fat-liquoring, are

dried, damped in, and set; they are then ready for blacking. They may be blacked on the table; first brushing on a solution of logwood and fustic extract,—6 oz. logwood extract, 1 oz. fustic extract, and ¼ oz. washing soda in 1 gallon of water,—and following this with a solution of iron,—8 oz. copperas (§444), and 1 oz. copper sulphate, per gallon of water;—finally brushing over with water, to remove excess of iron, setting, and oiling over with a mixture of equal parts of neatsfoot, and mineral oils.

§964. In the cheaper classes of combination chrome-leathers, the dyeing black may be done entirely with coal-tar dyes, the basic blacks or direct colours (§347) being most suitable. It is possible by using suitable dyes to dye the grain side of a skin black, and its flesh side a useful shade of blue or grey, at one operation. Much may be said for the use of coal-tar dyes from the point of view of economy in time and material. The addition of a little logwood to the dye-bath, as above recommended (§960), is a great advantage, it helps to overcome the liability to the production of a greyish bottom, to which there is a tendency when the coal-tar dyestuffs alone are employed.

§965. A list of dyestuffs suitable for this combination-chrome blacking will be found in the Appendix. There also will be found a list of a limited number of dyes employable for table-blacking (staining) combination-chrome leather instead of logwood and iron.

§966. Coloured Combination-Chrome Leather.—In the case of goods that are to be dyed brown or other shades of colour, the goods go through the operations of stripping and retanning exactly as with goods that are to be dyed black. After the retannage with a chrome liquor, and being washed and boraxed, the goods are ready for dyeing. The dyeing is best done in the drum, and the acid dyes (§330) are to be preferred generally, to the basic dyes (§301) for the purpose. It is often advantageous however to use both acid and basic dyes, treating the goods first with an acid dye-solution, and then topping with a basic dye; the basic-dye solution being added to the practically-spent acid-dye solution.

§967. The fat-liquoring of coloured combination-chrome goods is preferably done after the dyeing, though in some works the fat-liquoring operation precedes the dyeing. When done after the dyeing, the greater portion of the spent dyebath-liquor should be run to waste, and the fat-liquor then added to what remains.

§968. The finishing of coloured combination-chrome is similar to that gone through when blacks are being manipulated, except that it is usual to 'flame' coloured combination-chrome leathers, by brushing them over when dry with a weak solution of the dye, in order to get a good and full level colour. The addition of a small quantity of glycerine to the flaming solution helps in the production of a soft-feeling grain.

§969. With coloured combination-chrome calf it is usual to simply glass the goods in the finishing, instead of glaze them under heavy pressure. In the case of black 'box' the goods must of course be glazed. If the goods are to be pressure-glazed, this is best done after they have been perched, seasoned, and grained. It is preferable to grain before glazing, as this ensures the production of a fine grain.

§970. In the case of combination-chrome kip sides, kip shoulders, hide bellies, etc., that are to be dressed for box, it is advisable that they be lightly printed (§811) before the first glazing. The goods are then to be grained by hand, dried, seasoned, and glazed; and are again to be grained after the final glazing, being finally oiled over with warm oil (§940).

CHAPTER XXIV.

The Dyeing and Finishing of Alumed Leather.

§971. In the application of colouring matters to alumed leathers, for instance, alum kid, and white leathers, the dyer has to deal with a leather the properties of which differ from those of vegetable-tanned leathers and also from those of chrome-tanned leathers. In the first place he is working upon a leather the tannage or dressing of which is more or less removed by the soaking and dyeing operations, whether the dyeing is being done in the drum or by dipping; and this tannage or dressing must necessarily be restored to the leather after the dyeing of the goods. In the second place, the leather upon which the dyer is at work is *mordanted*, mordanted with alumina, the goods having been converted into leather by treatment with a solution of alum (§453), or aluminium sulphate (§452), and common salt, with the customary addition to the 'tawing' paste, as it is termed, of flour and yolk of egg so that the resultant leather may have a full feel and be plump and soft.

§972. Before the goods come into the dyer's hands, they have been kept in a crust (§2) condition, for, usually, one or two months. The keeping of the goods in this condition is commonly termed 'ageing' them. In this interval of 'ageing,' the tannage is held to fix itself in the goods, as it were, so that in the subsequent soaking and dyeing operations it is less liable to removal.

§973. The dyer's first operation with alumed leather, is to soak the goods in tepid water, water at a temperature of 35°C. (95°F.). The water should be used sparingly; to use a large quantity of water tends towards the removal of too great an

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amount of the dressing that is in the goods. This soaking, besides making the goods wet, and thus ready for dyeing, removes superfluous alum and salt, as well as also a considerable proportion of the egg-yolk.

§974. The operation of soaking is a very important one, and requires to be thoroughly and intelligently performed. The best method of procedure is to place the goods, in their superficially wet condition in a drum, and to drum them until they are thoroughly softened and evenly wet throughout. The drumming should be continued until no white spots are visible on the leather. The box form of drum (§253), or the polygonal drum (§270), are most suitable for this purpose. The vigorous knocking about that the goods receive when treated in these kinds of drum, (see also §267), conduces to their getting into the thoroughly 'wetted out' condition that is necessary in order to ensure level dyeing. The white spots upon the leather come of small particles of starchy matter (from the flour) that have been deposited upon the goods from the original dressing. These are exceedingly difficult to wet, but if not wetted, and that thoroughly, they will bring about a more or less spotty effect on the dyed skins, the spots dyeing a much lighter colour than the rest of the skin. The longer the goods have been 'aged' the more firmly set and obstinate are the spots, and the longer will the drumming have to be kept up in order to get the spots thoroughly wet.

§975. After the drumming the goods should be passed through tepid water; this done the goods are ready for re-dressing or dyeing.

§976. The subsequent dyeing operation is, according to the goods under treatment, to either dye them by immersion in the dye-solution, whether by tray method or by drum, or to brush-dye (stain) them on the table (§560).

§977. First of all suppose that the goods are to be brush-dyed. Then the first operation after the above-mentioned soaking is to 're-egg' the goods. On the Continent, and also in several of the glove-kid manufactories in England, the re-egging is carried out by placing the goods in a large tub or vat, together

with the requisite quantity of egg-yolk diluted with a small quantity of water, and then subjecting them to a trampling under foot by two or three workmen with bared feet. The workmen get into the tub or vat and trample the goods under their feet until the egg-yolk has been thoroughly absorbed.

§978. The more up-to-date method however is to re-egg in the drum, and the particular type of drum most in favour for the re-egging operation is the box-form (§253), or the polygonal drum (§270). The goods are drummed in the egg-yolk solution for, usually, one or two hours, the drum being occasionally stopped and ventilated, in order to allow the goods to cool. The cooling is necessary; without it the goods, owing to the friction set up by their being thrown about in the drum, become over-heated and thereby spoiled.

§979. The amount of egg-yolk employed varies in different manufactories, and according to the class of goods under treatment. Usually it is about equal to one per cent. on the weight of soaked and drained leather. Often the egg-yolk is supplemented by the addition of flour, sometimes by that of salt; also alum is occasionally added. If the goods in the first instance have been well leathered, that is thoroughly 'tawed' or tanned, neither of these three additions is to be recommended when the goods are to be dyed in colours. If the goods are to be blacked, the flour addition may be made, but it is inadvisable generally to make addition of salt or alum, as these substances have a tendency to spue out as a white crystalline deposit on the finished goods, especially after long storage in a warm or damp atmosphere; the objectionable deposit often showing itself after the leather has been made up into gloves. It has also been stated that the addition of salt to the egg-yolk emulsion when re-egging, militates against the production of a good gloss in the finishing of the leather. That addition moreover, owing to the hygroscopic nature of salt, is liable to bring about an objectionable dampness in the goods, and to produce mildew when the goods are kept in a damp atmosphere.

§980. The egg-yolk is applied to the goods in the form of a

thin 'cream-like' emulsion, prepared by dissolving the yolk in about five to six times its own weight of tepid water; water, that is, at a temperature of about 25° C. (77° F.); the drumming being kept up for the time stated above (§978).

§981. The goods, after the re-egging, are removed from the drum and horsed up for some hours. They are then placed on the staining table and gently sleeked out, with a wooden or vulcanite slecker (§107); this done, they are ready for the application of mordant and dye-solution. For the skins to take the dye, the usual preparation is to brush them over with a weak alkaline solution. Stale urine used to be in particular favour as a mordant for this class of leather and it is still largely had recourse to on the Continent. Instead of this must-be nastiness however, a weak solution of ammonia, or of ammonium carbonate may be made use of, as well as various of the commercial washing powders used for laundry purposes. *e.g.* Hydrolene. For many colours a weak solution of Turkey Red Oil (§629) may be employed, and is both cheap and effective; sodium silicate ('water-glass') and sodium phosphate are also useful in special cases.

§982. After the application of the 'mordant-sig,' the goods are brush-dyed with the dye solution. The natural dye-woods are still largely resorted to. Fustic (§407); golden-tan bark; Brazil wood and peachwood (§410); quercitron; turmeric (§418); log-wood (§386); willow and alder barks; etc., are mostly favoured.

§983. It is of extreme importance when treating alum leather that is to be subsequently used for glove purposes, to avoid the use of any natural dye-wood that contains much tannin. For the effect of the application of a decoction of any such dye-wood, will be to considerably curtail the stretching property of the finished leather, the tendency of such application being to 'tighten' the leather, as it is termed.

§984. After the application of the dye-wood solution to the leather, the goods are often washed over with a weak solution of some metallic salt, (a 'striker' solution), in order somewhat to modify the shade. The salts usually employed for the purpose

are ferrous sulphate, (copperas §444), copper sulphate, (blue vitriol §471), zinc sulphate, (white vitriol), and potassium bichromate (§466).

§985. Topping with a weak solution of a basic dyestuff is also often practised; to it is sometimes added the 'striker' salt just above mentioned. (See further Table, page 205).

§986. The brush-dyeing is carried out in the same manner as already explained (§560), and the dye-solution is best applied warm; the commencement of the brush strokes being at the centre of the skin and the strokes being towards the edges. Methylated spirit may if desired be added to the dye solution. This addition has the effect of preventing the frothing of the solution during the brushing on to the leather, and it also to a great extent prevents the egg-yolk from being brushed out during the operation. Blacks are stained on this leather in a similar manner to that of the staining of blacks on to vegetable-tanned leather, using logwood; to which it is advisable to add a little fustic, in the proportion of one quarter to the quantity of logwood employed. And the leather is prepared to take the logwood by brushing it over with a weak solution of ammonia, ammonium carbonate, or of either of the above-mentioned mordants (§981).

§987. After mordanting, and staining with the logwood infusion, the leather is to be brushed over with a weak solution of iron. Ferrous sulphate is to be recommended, 4 ozs. of this salt to a gallon of water furnishing a solution of suitable strength. Great care must be exercised not to use an excess of the iron solution in staining this leather black, as this, like tannin, has the injurious effect of tightening up the grain, and at the same time giving to the leather a very objectionable harsh feel. Up to the present, there are no coal-tar blacks in the market which will give, either in dyeing or in staining alum leather, equally good results to those obtained by the use of logwood and iron.

§988. Bath and Drum Methods of Dyeing Alum Leather.—For the dyeing of glove-kid and of white leathers the drum method is gradually superseding the brush method, and

just as above for the re-egging, the drum most in favour is of the square or polygonal form (§§253, 270). When the drum method is adopted, the goods, after being washed free from superfluous salt and alum, and being thoroughly wetted as above described (§974), are ready for the drumming. The skins are thrown into the drum with a sufficiency of water at a temperature of 40°C., and the stock solution of dyestuff is added through the hollow axle of the drum after the drum has been set in motion. The drumming is kept up until a sufficient depth of shade of colour has been obtained, an operation which usually takes about half-an-hour. When dyeing yellows or browns, it is advisable to first drum the goods in a weak solution of turmeric or golden-tan bark, until they are of a good yellow shade, and to get the final desired shades with coal-tar dyestuffs. The "grounding" with the wood dyestuff effectually prevents any 'gaping' or 'grinning' when dyeing with the colours mentioned. If necessary the shades may be dulled or saddened by the addition of a metallic salt to the dye solution, the addition being preferably made after the grounding, and before the obtaining of the final shades of colour with the aniline dyes. Iron, copper, and chrome salts (§§443, 471, 464) are the salts principally favoured for dulling; care however must be taken not to add too much of the salt, especially if potassium bichromate is made use of, in the dyeing of this class of goods. If there is any excess of the salt the finished goods will be hard, harsh, and have an 'insufficiently leathered' or tinny feel.

§989. When the skins have obtained the required fulness of shade, the greater portion of the dyestuff solution is run away, the egg-yolk mixture, as above described (§977) for the brush method, is added to what remains of the solution, and the goods undergo dressing in the mixture for a period of thirty minutes in order to replace in them the egg-yolk which has been washed away during the dyeing operation and to nourish or fat-liquor the goods.

§990. The egging is one of the most expensive items in the manufacture of this class of leather; for the egg-yolk a partial

substitute may be found in a fat-liquor emulsion (see §601) of olive oil and a small quantity of egg-yolk. After the re-egging, the goods are removed from the drum, laid over a horse, grain to grain, and allowed to drain for a few hours, after which they are lightly slicked out and dried. The drying is preferably done at the ordinary temperature of the air, (weather drying). If the drying is done at too great a heat, the goods will be hard, and as if they had not been sufficiently tanned or tawed, and considerable difficulty will be encountered in getting them soft by staking.

§991. The bath or dip method of dyeing is usually gone through in the manner already described (§224) for vegetable-tanned leather. The dip method however is not to be recommended except where very small quantities of skins are being dealt with at one time; for the process, besides being laborious, does not give so good a result as the drum or brush methods.

§992. When the leather that is being prepared is to be used for ladies' gloves, and a white flesh side is required, the drum method has the disadvantage that the flesh side of the leather is dyed as well as the grain side; for such leather therefore the brush method of dyeing must be adopted.

§993. A method of dyeing which has proved successful is, before dyeing the leather, to mordant it with a solution of chrome-alum, and then to dye with the coal-tar dyestuffs. The leather, after wetting back, is drummed for half-an-hour in a solution of chrome-alum at a temperature of 35°C., from 3 lbs. to 5 lbs. of chrome-alum being made use of for each 100 lbs. weight of the wet leather. After this drumming the waste liquor is run off from the drum, the coal-tar dyestuff solution is added, and the drumming goes on for half-an-hour. A useful addition to the dyebath is that of a quantity of bisulphate of soda equal in weight to that of the dyestuff used. By the adoption of this method the dyestuff penetrates well into the leather, and shades of colour of great depth and evenness are obtained. The treatment first of all with the natural wood-dyes is usually not necessary when this method is adopted, but can be gone through

if considered desirable, and the goods be topped afterwards with the coal-tar dyestuffs, in the same way as described above.

§994. Blacks may be dyed in the drum with a mixture of logwood and fustic, the goods being drummed for half-an-hour; about 5 per cent. weight of logwood extract on the weight of the wet goods being used, and 1 per cent. of fustic extract. After the drumming, three-quarters of the bath is run away and a solution of iron is entered; about ¼ per cent. of ferrous sulphate (§444) on the wet weight of the goods will be found sufficient. The solution of iron having been run-in through the hollow axle, about 12 revolutions, not more, should be given to the drum. After the drumming, the solution may be run off, and the goods washed in a little warm water, when they are ready for re-egging. Care must be taken in the washing of the excess of iron out of the leather; as if this is not washed out, the goods are apt to spue up a white deposit on the grain surface of the finished leather (see also §979).

§995. Many alum-kid skins are dressed white for gloving. In such dressing, the goods are soaked (§973) and afterwards lightly re-egged. Care must be taken not to use too much egg-yolk on this class of kid; an excess imparting an objectionable yellow tint to the goods; this can be overcome to a considerable extent by adding a very small quantity of indigo-carmine (§439) to the egg mixture, in order slightly to "blue" the skins. A better lustre on the finished goods can be obtained by the addition to the egg-mixture of 1 to 2 lbs. of French chalk per dozen skins; the addition has no detrimental effect on the egg-yolk. The goods are allowed to lie in the mixture for from 2 to 3 hours after the drumming, instead of being immediately removed and allowed to drain. Having lain in the mixture for the time stated, the goods are lightly slicked out and dried. A drumming in a dry drum after staking (§§684—691), with the addition of a little French chalk considerably improves these kinds of goods, giving the skins the desired nice, slippery (soap-like) feel, as well as improving the whiteness of the leather.

§996. The goods when quite dry are ready for finishing. The

finishing of alum leathers is very much like the finishing of chrome leathers; indeed the finishing processes employed on the latter kinds of leather have been adapted, and in the main adopted from those used on alum leathers.

§997. The goods are first damped to a suitable condition for staking by packing in damp sawdust for a few hours. They are then piled up one skin above another, the skins being laid grain to grain, and the pile covered over with clean sacking or a waterproof sheet to prevent the exposed edges of the skins becoming too dry; and the pile is then left for a few days to allow the moisture to become equally spread throughout. The skins now are thoroughly staked, an operation which is invariably carried out by hand over the upright staker (§684). After staking in their present slightly-damp condition, the goods are dried and re-staked, being afterwards well pulled into shape over the staker horse (§686), and they are then fluffed on the flesh side, the ordinary fluffing wheel being used for the purpose. Instead of staking the second time, the goods are sometimes perched with the crutch stake (§696) or the mooning knife (§694).

§998. After fluffing, a small quantity of thin mucilage is applied, made of linseed or Irish moss, to which a little dye solution is added sufficient to tint the mixture. Tragasol (§754) is also a suitable mucilage to use on this class of leather. The addition of a small quantity of glycerine to the mucilage is advantageous, giving the goods a nice soft feel.

§999. After the mucilaging the goods are well brushed, preferably by machine, and they are then ironed (§830). The iron used on these skins should be a heavy one, and the ironing should be done on a thick felt bolster. After the ironing, the application of a little French chalk to the grain side of the skins is to be recommended, the goods being again well brushed. Instead of the brushing, a final finishing with a plush covered wheel is much to be preferred.

§1000. Quite a latter-day introduction is Suede leather. Suede leather is alum-dressed sheep finished on the flesh side. The

goods usually chosen for this finish are those which are inclined to be faulty on the grain, and therefore unsuitable for finishing on that side. After being prepared and re-egged, if the dyeing is to be by the brush method, the goods are fluffed on two or more fluffing wheels; the fluffing commencing on a wheel with a moderately fine emery, and finishing on a wheel with a very fine emery, and they are finally pumiced, either by rubbing over with a small piece of pumice-stone whilst the goods are on the table, or whilst they are fastened in the perch.

§1001. After the production of a fine flesh surface the goods are brush-dyed, or dyed in the drum. When brushed-dyed it is the practice, for greys and slates, to use a mixture of wood dyestuff, coal-tar colouring matter, and a natural pigment, for example, Fullers earth or Charloboro clay. The use of the latter conduces to the production of a very fine nap finish when the goods are re-fluffed.

§1002. In the case of the colouring of alum-sheep for cheap. finish, for such articles, say, as ladies' fancy-slippers, where price is a very great consideration, the following method has in several hands given very good results. The skins, which are usually purchased in the white tanned condition after ageing, and are generally of foreign (usually French) manufacture, are simply taken as received, and, for mordanting, brushed over with a solution of a one-per-cent mixture of equal parts of sodium phosphate, and dextrine (British gum).

§1003. Immediately after the application of this mordant the dyestuff is brushed on to the leather. The colour has to be specially chosen for this method, and many of the direct cotton colours are particularly suitable to it. For example, Eosine and Erythrosine give brilliant shades of red and reddish scarlet; Auramine, and Picric Acid are suitable for the production of yellows, and for amber shades. After the application of the one-per-cent dye solution the goods are dried, the whole procedure being completed in a very short time. Afterwards the goods are staked somewhat, and very lightly brushed over, a sufficiently good finish for this class of leather being thus produced.

§1004. In addition to the ordinary alum-kid, there is a kind of combination-kid that is used in the manufacture of heavy driving-gloves. These heavy gloving-leathers are dressed by partly tanning the skins with a vegetable tanning-material, (usually gambier) in admixture with wood dyestuffs, (generally peachwood and fustic), and then further dressing them with alum, salt, flour and egg. For the manufacture of these driving gloves, heavy sheep-skins (" Cape sheep ") are chiefly used. It will be noticed that, in the case of this leather, the dyeing precedes the alum tannage. After the tanning the goods are dried, and lightly re-dyed in the bath with coal-tar dyes. They are then dried-out at a low temperature; and afterwards damped-back by placing them in a box with layers of damp sawdust between the skins, and are left for some hours in order that the moisture shall become equalised. When the goods are sufficiently damped they are staked, either by machine (§687), or by hand (§684); the hand method, (knee-and-hand method as practised on the Continent, see §684), being most in favour when the skins under treatment are sheep-skins. After the staking, the goods are dried, re-staked, and then lightly fluffed on the flesh side.

§1005. The finishing of black dull-finish alumed leathers, *e.g.*, calf kid, consists usually in the application of a soap and wax mixture, (½ lb. beeswax, 1 lb. curd soap, ½ lb. neatsfoot or olive oil, 2 oz. nigrosine, 1 gallon water), afterwards ironing with a warm tailors' iron (§830), and finally lightly oiling over the grain surface with olive oil.

§1006. Black gloving leathers are generally seasoned with a weak solution of soap, wax, and olive oil, to which is sometimes added a small quantity of nigrosine, afterwards ironed, and finally polished with a flannel.

§1007. Coloured goods are simply sponged over with a weak solution of gum-arabic or albumen, dried, and ironed; brushing with a soft brush, after dusting over with a small quantity of French chalk, usually completing the finishing operation.

§1008. Great care must be taken in the matter of the finish, that this is not of such a nature as to interfere with the stretch of the skin, or to fill up the grain of the leather.

CHAPTER XXV.

The Dyeing and Finishing of Oil-Tanned Leathers.

§1009. When dyeing oil-tanned leather, such as chamois leather, deer skins etc., the dyer has to deal with a material that is very different from the leather that follows from either vegetable tannage or mineral tannage. The leathers tanned by the chamoising process are chiefly sheep fleshes, (the ordinary chamois, "mock-doe," shammy, or wash leather), and the skins of the buck and doe.

§1010. The skins to be dyed require careful sorting. The usual course of procedure is to first sort the goods for size and quality and then to stake them, the best plan however is to first stake the goods and then to sort them afterwards. When the goods are to be dyed with coal-tar dyestuffs, 'cockled' goods should be sorted out as unsuitable; the hard spots that are observable on such goods do not take the dye satisfactorily, and it is only when the colouring is to be done with ochres, clays, etc., that such goods may be made use of. When it is the intention to dress the goods for glove leather, as imitation buck for example, then skins that are free from blemish, that are good, soft, stout, and level, should be chosen whenever possible.

§1011. Preparation:—The goods after staking are first grounded. The operation of grounding consists in levelling down the substance of a skin by cutting away its convexities with a moon knife (§694); the edge of the knife, for the purpose of grounding is slightly turned over (§694), and becomes the cutting edge. During the operation the goods are held in the perch (§693), and each piece of leather is worked in the perch in eight different ways. The grounding of a skin should be on one side

only of the skin, and the grounded side eventually becomes the finished side. Generally, but not always, it is preferable to make of the flesh side the finished side, especially when a good tight finished face is required.

§1012. After the paring down by the moon knife to an equal substance throughout, the skins are ready for fluffing (Chap. XVI). The object of the fluffing is to bring about as fine a nap as possible. Usually the goods are fluffed on two different wheels, first on a medium emery-wheel, and then on a fine emery-wheel. The skins after the fluffing are ready for soaking.

§1013. The goods should be wetted down by being placed in a tub of warm water. The skins are soaked for about half-an-hour, and are stirred and kept in motion continuously by means of a long wooden pole. When thoroughly soaked they are horsed-up for a short time to drip, and they are then ready for stripping. The purpose of the stripping is to free them from the oxidised oil and grease with which the goods are more or less coated. The stripping is best carried out in the drum, the goods being drummed in a weak solution of a soft soap of good quality.

§1014. To make the drumming-solution, 2 lbs. of soft soap for every 100 lbs. weight of drained leather should be dissolved in about 50 gallons of water at a temperature of about 40°C. The goods should be drummed in this solution for half-an-hour. At the end of the drumming they should be quite clean and clear, and free from any yellow spots of oxidised oil. If not thoroughly freed from grease and oxidised oil, more dissolved soft-soap should be added to the drum-solution, and there should be a further drumming for half-an-hour. The stripping being now completed, the goods are removed from the drum, and are ready for bleaching.

§1015. Bleaching:—The bleaching of oil-tanned goods is usually open-air bleaching; sun, or grass-bleaching as it is usually termed (§§162, 163). When this method of bleaching is the chosen method, the goods, after their soft-soap stripping, are

horsed up, without washing, and allowed to drain, and are then taken and laid on the grass in a meadow or other exposed site, and there left until night. The goods are laid out with that side (grain or flesh as may be) of each skin uppermost, which is considered to be the best side, and therefore is to be the finished side (see §1011). The next day the goods are soaked in strong soap solution and exposed as before; and the exposure is daily repeated until the goods have attained the requisite whiteness. The process is long and tedious, especially in the winter months; moreover the operation is only feasible when a factory is situate in open country, where the smoke and soot common to large towns are conspicuous by their absence. The sulphur bleach (§164) is a much less laborious process, as is also the permanganate bleach (§179), and these processes give results quite as good as those of open-air bleaching. The permanganate bleach is specially suitable for this class of leathers. The bleaching of chamois by hydrogen or sodium peroxide is also a method that claims attention.

§1016. Colouring.—The colouring of chamois leather is commonly effected by the use of pigments (§1021), but it is possible to dye chamois leather, and oil-dressed leathers generally, both with the coal-tar colours, and the natural dyestuffs. The results brought about when the coal-tar colours (§295) are applied, and especially when the alizarine colours (§361) are employed, are highly satisfactory, and greatly superior to the results obtained when pigments are made use of. The coal-tar method of colouring nevertheless is of restricted application, because of the many defects that are common to chamoised goods and that militate against level dyeing. Patches that refuse to properly take a coal-tar dye are of course readily enough covered by a pigment, and hence it is that the colouring of chamois leather is mostly by pigment. To a considerable extent however chamois leather is dyed, when the skins are of good quality and are being treated for imitation buck and doe, as well as when real buck and doe skins are being dressed.

§1017. In preparing skins for colouring by pigments, the

first operation after bleaching and then washing, is the 'tucking.' The washed goods are wrung out, usually by passing them through an ordinary household wringing-machine, the wrinkles are removed by shaking, and the goods are placed on a horse. This partial drying may be done in a hydro-extractor, see pages 423 and 424, Figs. 199 and 200.

§1018. TUCKING:—The tucking vat is a wooden vat or tub, provided with a steam pipe which goes to the bottom of the vat, and ends in an upward bend. Steam is passed into the water with which the vat is filled, until the water is raised to boiling point. Now 5 lbs. of soft soap per 30 gallons of water is usually added, and the mixture is boiled until the soap is dissolved. The employment of an emulsion or fat-liquor (§601) of soap and oil is to be recommended however in preference to the plain soap-solution, as the goods tuck better in such fat-liquor, and a softer and better finished leather is brought about.

§1019. For a suitable fat-liquor, 1 lb. of cod oil should be added to the 5 lbs. of soft soap and 30 gallons of water specified above, and these ingredients should be emulsified together (§612); in quantity this fat-liquor would be sufficient to tuck 20 dozen of chamois.

§1020. The immersion of the skins into the boiling soap or fat-liquor solution is one at a time. On the dipping of the skin into the boiling liquor, it immediately draws up, shrinking to about one half its usual size, and has the peculiar curled appearance common to leather that is immersed in too hot a liquor, the leather apparently being completely spoiled. The skins, one by one as they are tucked, are hung up in a hot stove, and exposed to a heat of not less than from 49°C. to 55°C. (120°F. to 130°F., that is). When the goods are dry they are staked to soften them and bring them back to the soft condition they were in before tucking, the operation being usually carried out on the upright stake (§684), but sometimes the operation is done in the perch (§692), using the crutch stake (§696). After the staking, the goods again undergo fluffing, the fluffing being mostly on a

solid emery-wheel (see Fig. 142) or on a solid stone wheel; this done the goods are ready for colouring.

§1021. For pigment-colouring the usual painters' pigments are employed, ochres and umbers being used for the production of brown shades. The pigments are mixed up with water, in which preferably a little gum-arabic has been dissolved (1 oz. of gum arabic to 1 gallon of water). The colour is applied in the same manner as in leather-staining (p. 197), and the application is made to the dry leather. After colouring, the skins are hung up in a warm stove to dry; they are then staked, the working of the goods over the stake being on that side of the skins which has not been coloured. The goods are now 'dusted,' loose pigment-powder being beaten off as dust, that is; the skins being taken, two or three at a time, and beaten against a small wooden stool, 28 inches or so high. The skins are now again fluffed on an emery-wheel, this time a very fine emery-wheel. Finally the skins are again brushed with the pigment-mixture, again dried and dusted, and also again fluffed. These operations are sometimes repeated and re-repeated, until the leather has acquired a fine velvety feel and a good solid level colour.

§1022. When the goods are to be dyed with coal-tar colours, it is necessary that, after their bleaching they should be mordanted.

§1023. The more generally useful mordants for the purpose are, aluminium sulphate (§452), chrome alum (§464), potassium chromate (§467), and potassium bichromate mixed with lactic acid.

§1024. The goods to be mordanted are placed in the drum, the drum is started, and the mordant is then run in, a small quantity at a time. The mordanting is done at a temperature of 30°C., and the more knocking about the skins undergo during the drumming the better. The drum should revolve at about 12 to 14 revolutions per minute.

§1025. Aluminium sulphate is just above given as a mordant when the dyeing is to be with coal-tar colours. It is however

when the dyeing is to be with the natural dyestuffs that this mordant has its most useful place (Chap. VI., p. 144). The other mordants mentioned are to be preferred when the coal-tar colours are to be made use of in the dyeing of the goods, especially in the case of the alizarine browns (§361).

§1026. In mordanting with the potassium bichromate and lactic acid mixture, 2 lbs of the bichromate should be dissolved in water and 3 lbs. of lactic acid added to the solution, the quantities named being those necessary for every 100 lbs. of wet drained leather. The goods should be placed in the drum with about 20 gallons of water, and the mordant mixture, a small quantity at a time, should be run in through the axle during the drumming.

§1027. The goods are to be drummed in this solution for half-an-hour, when a skin, on being cut, should show that the mordant has penetrated right through the leather. If potassium chromate is used for the mordanting, 3 lbs. of it in the 20 gallons of water will be a sufficient quantity. In the dyeing of yellows and medium browns, the last-mentioned mordant and that just previously mentioned are the two most useful mordants.

§1028. In the dyeing of dark browns, the best mordant is chrome alum; 3 lbs. of it to the 20 gallons of water is the quantity to use. The solution should be made basic by the addition to it of ¼ lb. of washing soda previously dissolved, and the solution should be boiled.

§1029. After the goods are mordanted they are removed from the drum, horsed up, and allowed to drain. Goods mordanted with the bichromate and lactic acid mixture should be covered over so that they may not suffer from exposure to light. After the draining of the goods, the dyeing should be proceeded with as soon as may be. In no case should the goods be allowed to lie about for more than 24 hours, or they are liable to become stained, and will not dye satisfactorily.

§1030. The dye solution in the drum should be used at a temperature of from 40° C. to 50° C. Many of the alizarine (§361),

and anthracene browns (§361) are particularly suitable for dyeing chamois, (see also Appendix A.) These dyestuffs furnish good commercial brown shades of great fastness both to light and to rubbing. In the dyeing, bisulphate of soda should be added to the dye solution, in amount, say, equal to that of the dye used; that is to say, if 1 lb. of dye is used, 1 lb. of bisulphate of soda should be added to the dye bath.

§1031. The goods are entered in the drum for the dyeing, without washing, after their drainage from the mordant solution, and the dye is added through the hollow axle of the drum as it revolves. Half the dye should be run in at the commencement of the dyeing, and there should then be a 10-minutes drumming, during which time the dissolved bisulphate of soda is added. There should then be a further 10-minutes drumming, when the remainder of the dye should be added; and, the drumming being now continued for 20 minutes more, the goods should be sufficiently dyed. The dye should penetrate the leather right through and it should be evident on cutting a skin that it is coloured right through. The alizarine dyestuffs are sold in both paste (20%) and the usual powder form; the author's experience is that the paste form is to be preferred in this drumming.

§1032. When the goods are effectually dyed, about a quarter of the dye solution is run away and a little soap-and-oil fat-liquor is added to the contents of the drum. For 5 dozen chamois skins the fat-liquor may be made up of 4 oz. of soft soap and 4 oz. of neatsfoot oil boiled together in about 1 gallon of water and then emulsified with the addition of 2 egg-yolks. It is an advantage to add a little scent to the fat-liquor, as it disguises the smell of the neatsfoot oil; a little birch-tar oil, that used in scenting Russia leather, is useful for the purpose.

§1033. The fat-liquor is added through the hollow axle of the drum and the drum is revolved for another 15 minutes, when the goods are taken out and horsed up; they are afterwards washed, struck out, and dried, the skins for the drying being hung up by the hind shanks in the stove.

§1034. When the goods are dry they are ready for staking. After staking the goods are grounded (§1011) and finally fluffed. In order to produce a fine close-textured finish the goods may be treated with a mixture of pigment and water (§1021), and dried, staked, and dusted, before the fluffing.

§1035. If thought necessary the goods may be flamed by brushing over with a solution of a suitable dyestuff, *e.g.*, a basic or acid dye (§300). The alizarine dyestuffs are not generally suitable for this purpose, their insoluble character necessitating their being used at a temperature over 60° C. in order to keep the dyestuff in solution.

§1036. When dyeing brown shades for gloving-leather finish, a little tannin solution, oakwood or chestnut extract for preference, is a useful addition to the dye-bath if the dyestuffs employed are unaffected by the addition, "acid" or alizarine dyestuffs, for example. When basic dyestuffs (§301) are employed for the dyeing, the "bark liquor" may be added to the goods in the drum half-an-hour before adding the dyestuff.

CHAPTER XXVI.

Oils and Fats.

§1037. Oils and fats play a very important part in the dressing and currying of leather. To every class of leather, practically, application has to be made of some kind of oil or other. It is not within the scope of this work to go into detail as regards the chemical constitution of these substances; it will suffice to say, that with the exception of temperature at melting and solidifying points, there is, for leather purposes, no essential difference between solid fats and oils, whether of animal, vegetable, or mineral origin. For special information in the matter of the chemical technology of oils and fats, the reader is referred to the standard works on the subject.*

§1038. Tallow.—Tallow is the hard fat obtained from various animals. The ordinary classification of it is as beef tallow and mutton tallow. The former, usually more soft and yellower in colour than the latter, is the fat of bulls and oxen. Its melting point is about 40°C. (104° F.); but this varies somewhat, owing to the fact that fats of different consistency—the harder, stearin, and the softer, oleine—are obtained from one and the same amimal, the feeding of the animal telling importantly in this particular.

§1039. Mutton tallow is obtained from sheep, and occasionally goats. It is a much harder tallow than beef tallow, and its melting and solidifying points are higher, the former being about 50°C, (122° F.) Tallow is often adulterated with paraffin wax,

* Lewkowitsch, "Chemical Technology and Analysis of Oils, Fats and Waxes." (Macmillan, 1909.)
Allen, "Commercial Organic Analysis," Vol. 2. (Churchill.)
Alder Wright, "Oils, Fats and Waxes." (Griffin, 1904.)

distilled-grease stearin, and oils various; the adulteration taking the form, usually, of the mixture of an oil, and of hard stearin, or of paraffin wax.

§1040. Buck tallow was originally the fat obtained from the deer, and was much favoured for finishing purposes, (see §§1148, 1151.) Real buck-tallow is much harder than mutton tallow. But it is very scarce in England, and is now largely superseded by a mixture of a hard tallow and wax. For a serviceable buck-tallow substitute see §1149.

§1041. STEARIN.—Distilled-grease stearin is prepared by the distillation of Yorkshire grease, (§1042). In colour it is usually white or pale yellow; and its melting point in the best samples varies from 41°-55°C., (105°-131° F.) This stearin now enters largely into the composition of stuffing-greases instead of tallow.

§1042. WOOL-FAT AND YORKSHIRE GREASE.—Wool-fat and recovered grease is a bye-product in the process of wool-scouring. The soapsuds from wool scouring are decomposed by the addition of acid, and the grease is liberated. Commercial wool-fat is either yellow or brown in colour, and has a peculiar and rather offensive odour. The melting point of wool-grease varies from 39°-42° C., (102°-107° F.) Like dégras (§1048), wool-grease possesses the property of making an emulsion with water. It is largely used in the composition of stuffing greases as a substitute for dégras.

§1043. NEATSFOOT OIL.—Neatsfoot oil is obtained by boiling the feet of oxen and sheep in water and recovering the oil that is given out. It is an oil largely employed in fat-liquoring chrome leathers, particularly glacé kid, for which purpose it is particularly suitable and highly valued. It is a pale yellow oil and nearly odourless. As it is high in price, it is often adulterated with cotton-seed, mineral, and tallow oils. It is a good lubricant to the fibres of the leather, imparting the nice, soft, plump feel that is requisite in a well-dressed chrome leather. It deposits stearin or 'foots' on standing, especially so when exposed to cold. The presence of stearin is objectionable in that it is liable to spue-out on the finished leather as a white deposit. The best grades of this

oil are subjected to what is termed the cold test, that is, they a[re] carefully 'racked' to separate out the stearin at a low temper-ature.

§1044. *Cod Oil.—Of all oils, that which perhaps is most* extensively used is cod oil. It is obtained from the livers of the cod fish, the *gadus morrhua*. Cod oil, as sold to the leather manufacturer, the brown oil of commerce, is prepared from the livers of cod fish which have been placed in barrels by the fishermen, and are in a state of putrefaction when they reach the cod-oil extractor. The extraction of the oil is effected by boiling up the livers in water by means of steam, and skimming off the oil which rises to the surface; or by allowing the livers to wholly putrefy in large wooden or iron vats, and then skimming off the floating oil. The temperature of the procedure, in the matter of the oil extraction, no doubt plays an important part as to the behaviour of the oil when used on leather, and there is room for investigation by the scientist on this line. The oil, after extraction is 'racked' by being allowed to remain for some time in a suitable tank, until 'foots,' or stearin, or other soluble matter has settled; when the clear oil is drawn off and barrelled. Coast cod-oil, an article largely offered to the leather trade, is obtained from the livers of almost any fish, the chief being hake, haddock, and ling. Cod oil is largely adulterated, mainly by the addition of shark, menhaden, and whale oil. Mineral oil is a very common adulterant. The principal use of cod oil is in currying (p. 390), and in the oiling-off of various leathers. It is one of the oils known as drying-oils; the drying being an oxidation-process coming about when fish, linseed, and some other oils are exposed to the air. This drying quality is one of the chief causes of the defect called spueing; the 'spue' being the sticky, resin-like substance which occasionally appears on the surface of curried leathers. The precise conditions however under which spueing takes place have never yet been satisfactorily ascertained (see also §1068).

§1045. Whale Oil.—Whale oil is obtained by extraction from the blubber of various species of whale, but it is not under this name that it is often purchased by leather manufacturers. It

is a useful substitute for cod oil, and as it is not so liable to oxidation, leather treated with it is less subject to spueing.

§1046. Seal Oil.—Seal oil is obtained from the blubber of various species of seal. It varies in quality considerably; pure seal-oil being almost white in colour, and the commoner of a dark brown. It is used to a considerable extent in currying. Some manufacturers use it for oiling-over the leather after dyeing and before drying. With the hand leather-shaver seal oil is a great favourite (§82).

§1047. Menhaden or Herring Oil.—This is one of the cheapest of the fish-oils; it is obtained by boiling herrings. It is not generally purchased for currying, but as stated above (§1044) it is often added to cod oil. Being a highly oxidisable oil, it is particularly conducive to spueing (§1072).

§1048. Dégras and Sod-Oil.—Dégras is a bye-product in oil-tannage, in for example the chamoising process. It is the oil expressed from the skins by hydraulic pressure, or by wringing, after the skins have been several times treated with cod oil, and allowed to heat and ferment, and have become leather.

§1049. Sod oil is the grease recovered from the leather by treatment with a weak alkali: the soap emulsion formed being solidified by sulphuric acid and the oil set free. Dégras and sod oil are usually adulterated, with wool-grease chiefly. Sod oil is mostly sold in two forms, light and dark. In the light form it is of a pale yellowish-brown colour, and is the oil expressed from the skins after the first dressing, and is therefore similar to dégras. The dark sod oil is produced almost exclusively from the grease-soap solution recovered after treating the skins with an alkali; excessive moisture being got rid of by evaporation, the grease-soap being heated-up for a considerable time in a copper pan, after the addition of a small quantity of sulphuric acid.

§1050. The easy emulsification of dégras is above referred to; sod oil has the same property. It is this characteristic of these products that makes them of such value in currying and in fat-liquoring. For the latter purpose, a non-evaporated sod oil, or a dégras containing not less than 20 per cent. of water, is more

useful than the sod oil which has undergone evaporation; the emulsion, for such either of them is, being absorbed by the leather with greater ease, and more uniformity as regards colour, than an oil out of which the water has been evaporated.

§1051. Sod oils often contain free acid (sulphuric) or free alkali (soda), according to whether the sulphuric acid used in the above-mentioned separation of the oil has been sufficient or not to completely neutralise the alkali. A good sample of sod oil should of course be quite neutral; excess of acid acting injuriously on leather, as also is the case with excess of alkali. A little free alkali in the oil is however not very detrimental when it is a matter of fat-liquoring. Free acid is most undesirable always. In currying, when employing dégras in admixture and in conjunction with soap and other oil, for fat-liquoring, it is advisable to add the dégras, or sod oil last, and at a temperature not exceeding 40°-45°C. (104°-113° F.), in order that there may be no separation of the water present in the mixture, such separation being unwelcome. Dégras and sod oil are, both of them, and dégras in particular, largely adulterated. The chief adulterant is whale oil or recovered grease (§1042); but adulterations with tallow, soluble and resin oils are not entirely unknown; these however are easily identified by the chemist.

§1052. Linseed Oil.—Linseed Oil is extracted from the seeds of the flax plant, *Linum uitatissimum*. It is a drying oil, as stated just above, oxidising with extreme rapidity on exposure to the air, and becoming viscous. Its chief use in leather manufacture is in the oiling of dyed leather, in the finishing of black goods, and in japanning. It is not a suitable oil to use on leather however on account of its drying property, and it has of late years been largely superseded by sperm and mineral oils. Boiled linseed oil is used in enamelling as well as in japanning. By heating the oil with "driers," that is, litharge, manganese, borate, etc., the viscosity of the oil increases considerably, as also the weight; and it moreover acquires the quality of readiness to dry rapidly when exposed to air, thus producing a varnish. Raw linseed oil boiled with litharge and Prussian blue is the varnish used upon japanned and enamelled leathers.

§1053. Castor Oil.—This is a vegetable oil, obtained by expressing the seeds of *Ricinus communis*. It is a colourless and viscous oil with no drying property. Being a cheap oil, having the virtue of filling well, and being unaffected by the action of air, it is largely used in fat-liquoring, for which purpose it is particularly suitable when treating heavy leathers, such as calf, side leathers, etc. Castor oil is seldom adulterated. When adulteration is practised, cotton-seed, and resin oils are those most commonly found with it. Castor oil is used in the manufacture of Turkey red-oil, (§629).

§1054. Cotton-Seed Oil.—This oil is obtained by expressing the seeds of various kinds of cotton plants. It is an oil not very largely used in leather dressing, but being cheap, and possessing good lubricating qualities, it deserves more attention from the leather trade than it has hitherto received, particularly as a substitute for neatsfoot oil in fat-liquoring, and also for oiling-off dyed leathers. Being one of the cheapest vegetable oils it is seldom adulterated.

§1055. Sesame Oil.—Sesame oil is obtained from the seeds of the *Sesanum Indicum* plant. It comes chiefly from India, where it is known as gingelly or gingili oil. It is largely used by Indian tanners to impart weight to leather, being liberally applied to the wet leather before drying, (see also §134). It is not a drying oil and it easily turns rancid. In the dressing of many classes of leather it is particularly suitable for fat-liquoring. It has the peculiar property of being absorbed by leather in very large amount, (15 to 20 per cent.), without rendering the leather at all greasy or oily. When adulterated, the adulterants are usually cotton-seed oil, and rape oils. It is particularly to be recommended for general oiling purposes of light leathers.

§1056. Sperm Oil.—This is a thin pale yellow oil obtained from the sperm whale. It is used by some manufacturers for oiling chrome leathers in the finishing process; and it is also occasionally used in fat-liquoring. It is however one of the more expensive oils, and particularly liable to adulteration because of this, and it moreover possesses no advantage for oiling-off, over

cotton-seed oil. In currying it is of little or no use, as it is an exceedingly light-weighing oil, and possesses no such lubricating properties as required by leather. For lubricating light machinery it is a particularly useful oil.

§1057. Olive Oil.—Olive oil is obtained from the fruit tree *Olea Europosa Sativa*. It is well known as a drying oil. On account of its high price, it is very prone to adulteration with cotton-seed oil, aradies,sesame, and lard oils. In its properties it strongly resembles lard oil. Its chief use in leather dressing is in the making of soap for fat-liquor, and it has been largely used in America for this purpose. In the writer's opinion this oil possesses no advantages when used in the form of soap, over cotton-seed oil or castor oil. Olive oil has the peculiar and advantageous property when employed in the preparation of fat-liquor, that it contains a little free acid. Marseilles and green soap are usually prepared from olive oil.

§1058. Mineral Oils.—Mineral oils, also called petroleum, earth or rock oils are products of the distillation of oil deposits found in various parts of the world. Bituminous shale is also a source of mineral oil.

§1059. Various theories have been advanced by many eminent chemists and geologists as to the origin of petroleum. It is now supposed almost universally to have a double origin from animal and vegetable life, springing as it does from limestone, including sandstone and shales. Mendelejeff attributes the origin of the oil to the action of steam on the iron carbide of subterraneous mineral deposits and to the decomposition at high temperature and under pressure of the remains of marine life.

§1060. The crude oil is found chiefly in the United States of America, Canada and Russia. Oil wells, however, and petroleum yielding shales are to be found in all parts of the world. The paraffin industry in Scotland from the distillation of shale is quite a considerable one.

§1061. The most important products from the distillation of petroleum are:—Petroleum-ether (petrol), ligroin or petroleum naphtha, benzine or benzoline, kerosine (burning oil), lubricating

oil, vaseline and paraffin wax. American petroleum yields the whole of the above series of products. Russian oil does not possess the lighter and more volatile oils, the first chief product from its distillation being benzine. The tar obtained from the distillation of shale yields after purification and distillation naphtha, burning or paraffin oil and light mineral oil. The residue is treated for paraffin wax or 'scale,' a bye product from the process being the heavier lubricating oils. The various oils differ in properties and chemical constitution according to the source from which they have been obtained. Thus oil from the Russian oil fields contains a different series of hydrocarbons to the oils obtained from the American oil fields.

§1062. The mineral oils used in leather dressing are the light lubricating oils (sp. gr. 840—865) sold under many various names. Some crude petroleums are sold in their natural condition as mineral oil. The lightest of the lubricating oils are often called "neutral oils." The more volatile oils such as petroleum-ether and benzine are used for degreasing.

§1063. Petroleum oils are quite unsaponifiable, that is they do not enter into combination with soda or potash to produce soap. Mineral oils are largely used as adulterants of both vegetable and animal oils.

§1064. Before use for this purpose their colour and odour is removed by filtration through bone black. A very distinct characteristic of mineral oils is their blue flourescence or "bloom." This can be removed by the addition of small quantities of nitric acid, nitronapthalenes, nitrobenzene, etc. If a vegetable or animal oil is seen to possess the above-mentioned flourescence it may be generally assumed to be adulterated with mineral oil. The absence however of the flourescence does not by any means indicate that a vegetable or animal oil is free from mineral oil. In cases where it is advantageous to use mixtures of animal or vegetable oil with mineral oil it is generally much cheaper to make such a mixture from the pure oils rather than to buy an adulterated animal or vegetable oil.

§1065. Mineral oils are advantageous when used for lubrication purposes (§550); they are useful in currying and for oiling off various leathers; they however do not feed and lubricate the fibres of the leather so effectually as animal or vegetable oils, but being one of the cheapest class of oils procurable they may be employed with advantage in admixture with animal or vegetable oils; for this purpose they possess the property of assisting considerably in the distribution of the latter over the fibres of the leather. Mineral oils not being affected by oxygen do not spue (§1068). Where, as in the case of oiling leather before drying, in which case it is only necessary in order that the leather should dry of good colour, to cover over the surface of the leather with an air-proof seal (see also §585), mineral oils offer considerable advantages over other oils, being equally effectual for the purpose and much cheaper than either animal or vegetable products.

§1066. Paraffin Wax.—Paraffin Wax is one of the higher members of the paraffin series (§1061) existing in varying proportions in petroleum. It is now largely used in drum stuffing and stuffing by dipping. Owing to its high melting point, 46-60°C., considerable weight can be imparted to leather by its use; the addition of paraffin wax to the stuffing mixture increasing the melting point of the whole, thereby enabling the leather to carry more of the stuffing grease without the leather attaining an objectionable greasy appearance (see also §1108).

§1067. Resin Oil.—Resin oil or rosin oil is a cheap oil obtained from the distillation of resin. Resin oils are not used to a very considerable extent in leather dressing, though they are sometimes met with as an adulterant of cod oil. A small quantity of resin oil is often used as a constituent of the dubbin used in currying. An emulsion prepared by dissolving resin soap, made by boiling resin oil or resin with caustic soda, to mineral oil has been largely employed in fat-liquoring of sheep leathers for which purpose it answers well and has the additional advantage of being extremely cheap.

§1068. Spueing.—'Spewing' or 'spueing' is the term applied indiscriminately to the exudations various that appear on the

surface of leathers that have been 'dressed' with fatty matters. As this defect is intimately associated with the subject-matter of this Chapter, a few remarks on the two forms of spueing most commonly met with, and their causes, will not be out of place.

§1069. The commonest spue of all, and unfortunately one of the most harmful, shows itself on curried leathers. This particular exudation, which in very bad cases takes a gummy, resin-like form, is met with for the most part on leather that has been blacked with an ink or some iron compound; for example, black harness, 'satin,' 'memel,' etc.

§1070. The defect may be attributed generally to the action of the oxygen of the air on the drying-oil, say cod oil or herring oil, that has been made use of in the dressing of the leather, when the leather has been stored under conditions favourable to such action, or contains materials that facilitate it; iron, for instance, which may be spoken of as an oxygen-carrier. Temperature, moisture, and fermentation play, no doubt, each of them, a part in occasioning the ooze.

§1071. What exactly takes place in bringing about this resin-like spue, is a matter that has never yet undergone a thorough scientific investigation; it may however be taken as certain that the defect comes of the several agents mentioned, acting in unison.

§1072. If a leather stuffed with an oxidisable oil has applied to it an air-proof coating, the oxidisation of the interior oil can proceed but very slowly. Outside influences however, which exist always, heat and moisture for example, act in combination with what is going on in the interior of the leather, and the drying-oil in it, only partially oxidised, bursts through the outer coating of the leather and deposits itself on its surface in gummy form. Or the air-proof coating may be unintentional, may be oxidised oil forming a varnish-like covering to the leather; or it may be a soap produced by the leather having been brushed over with an alkali, say soda, or ammonia, to 'cut' the grease previous to the blacking, the oil in the leather not having had time to oxidise before the application of the soap covering. The

use of cod oil to 'set the black' after blacking, particularly if the oil happens to be adulterated with herring oil, or menhaden oil (§1047), may also help to bring about a spue, by forming such above air-proof or varnish-like covering to the leather. Tallow, or mineral oil is to be preferred for the purpose.

§1073. Metallic salts, for example iron (already spoken of), and copper used in the blacking compound, acting as carriers of oxygen undoubtedly play an important part in spue-production, by setting up oxidation in the oil-films that are uncombined with the leather fibres and are lying in the interstices, the oil having now, so to speak, a particular readiness for oxidation.

§1074. For the iron salts in the form of inks used for blacking curried leathers coal-tar colours may be substituted. This adds however a little to the cost, and the procedure with them is somewhat more difficult. Excellent blacks can however be obtained by the use of the spirit-soluble class of coal-tar colours, and these can be satisfactorily applied to the greasiest of leathers without any previous preparation of it.

§1075. The rancidity of an oil (the 'acid value' of it) is an important factor in the question of whether an oil is or not predisposed to gummy-spueing. An oil with a high acid-value (as found by analysis) should generally be rejected for ordinary currying purposes, as being unsuitable; and particularly so when the stuffing has to be done by hand (§1086), as the oil then must necessarily be more unequally distributed throughout the leather than when the goods have been drum-stuffed.

§1076. The addition of mineral oil to cod oil certainly assists in the prevention of spue, this being very probably due to the fact that it helps in the more even distribution of the oil over the leather fibres.

§1077. Cod, or other highly oxidisable oil should not be employed for the oiling-off of leather. Mineral oil, or a mixture of mineral oil with one or other of the less-oxidisable oils, such as cotton-seed oil, or olive or castor oil is to be preferred, when other circumstances which have to be considered permit of it.

§1078. The other form of spue above referred to takes the form of a white deposit of a greasy nature on the leather surface. This is due to the harder portions, stearin, of the fat used in stuffing being thrown out by, or slowly oozing out of the leather. It is really a crystallisation of the stearic acid in the leather, and is chiefly brought about by variations of temperature.

§1079. This white spue is not only common to curried leathers, but is often seen on chrome leathers, particularly glacé-kid fat-liquored with neatsfoot oil which has not been well 'racked' (§1043), at a suitably cold temperature, and comes of the formation of stearic acid crystals on the surface of the leather. The defect is never seen when castor, sesame, or cotton-seed oil is used in the fat-liquoring.

CHAPTER XXVII.

CURRYING.

§1080. The dressing of leather for saddlery, harness, boots and shoes, and other many purposes is termed 'currying.' The operations of splitting, shaving, scouring, sumaching, and setting, setting-out, or striking-out, as the operation is indifferently named, (the term 'scouring' indeed is often applied to it)—operations which precede that of currying, have already been dealt with in Chapters I. and XI. By the currying operation the leather is rendered soft and pliant, and by reason of the impregnation with grease that it receives in the 'currying,' it becomes also comparatively water-resistant.

§1081. This impregnation of the leather with oils and fats, so that each individual fibre of the leather, throughout, shall be infiltrated, is the essential of the currying operation. This operation of imbuing or saturating the leather with grease, so that each fibre shall receive lubrication is termed 'stuffing.' It may be performed either by hand, the procedure being then known as 'hand-stuffing,' now to be described, or by the drum (§1092), or by 'burning-in' (§1114), or by dipping (§1118). Carried out by either method, not only does each fibre become lubricated, but the interstices between the fibres are also filled-up with grease, so that the fibres, as well as being individually lubricated, are actually embedded in fatty matter.

§1082. In the preparation of leather for stuffing a paramount matter to be attended to is its previous saturation with moisture. The importance of this step of soaking and samming the leather will at once be recognised, when it is pointed out that if the

individual fibres or fibrils of the leather are not brought into a state of division by means of water, the capillarity of the fibres suffers injury, and the absorption by the fibres of the stuffing-grease is seriously retarded, and the leather is impregnated by the grease irregularly. And this is specially of moment in the case of hand-stuffing, where the oil and fatty matter made use of has to be absorbed during the drying of the leather, *pari passu* with the drying indeed; that is to say, as the moisture dries off the surface of a fibre and out of the interstices between the fibres, the fatty matter has to keep in actual touch always with the moisture, and to follow it up, and take its place; thus filling up the interstices and lubricating the fibres.

§1083. Samming by machine is a practice that is now largely resorted to, so that superfluous moisture may be removed before the stuffing operation and the goods be brought into the requisite condition of dryness. (See also Chapter XIII.)

§1084. The illustration below, Fig. 187, is of a sammying machine. In principle it is similar to the ordinary household

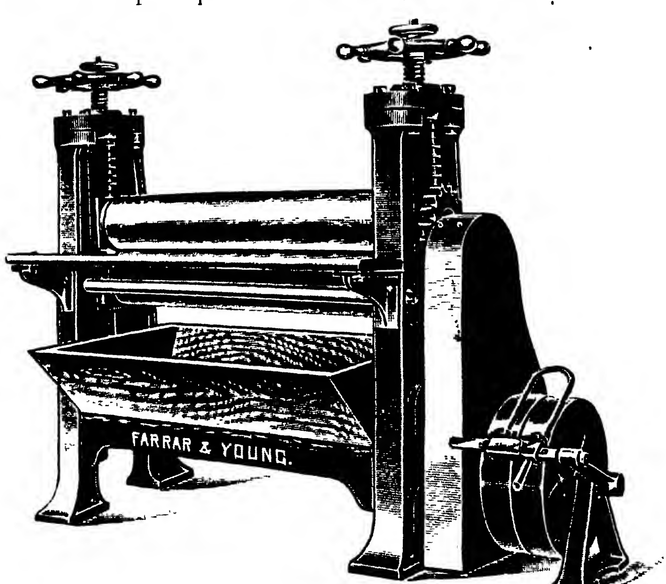


Fig. 187.

wringing-machine, that is to say, the material, leather now, from which all superfluous moisture is to be removed, is passed between two rollers, and is squeezed by them during its passage. The construction and composition of the rollers varies, the makers of the machines having their own fancies in the matter. One of the chief drawbacks of the machine is that, if the leather during its passage between the rollers happens to be doubled or folded upon itself, a mark is produced upon it which it is always difficult, and sometimes very difficult, to get rid of. The rollers are made by one manufacturer of compressed cloth, and it is claimed that by the use of this material for the rollers, there is no danger of damage to the leather, even if it should get folded.

§1085. Undoubtedly the samming machine is a useful acquisition to the stock-in-trade of the leather dresser; but although it will remove a large quantity of moisture from the goods, it does not suitably 'sam' them; that is to say it does not bring them into that precise condition that will allow of their being stuffed with success at once after passing through the machine; success in stuffing being looked at of course from the point of view of gain of weight in the finished goods and their colour. Usually it is necessary in order to bring the goods into perfect condition for stuffing, to hang them after their samming by the machine in the drying-shed for a further drying. The machine is certainly useful in equalising the moisture throughout the goods.

§1086. Stuffing by Hand.—In stuffing by hand, the leather is smeared over, usually on the flesh side, by means of a soft brush, with a mixture called 'dubbin,' which is ordinarily composed of tallow and cod oil. The amount of moisture present in the leather is a matter of very great importance. If the leather is too dry, the goods will be of a dark colour when finished, and especially so in the thin parts. To avoid this, the leather after being sammed as a whole, is usually further damped in the thin parts by a brushing-over with water just before the application of the stuffing. In the application of the dubbin much care has to be taken not to apply it in excess. The difference between a good and an indifferent currier is entirely a matter of the judgment he is capable of

exercising as to the right degree of samminess in the leather, and the proper amount of dubbin to apply.

§1087. The constituents of the dubbin and their proportions vary according to the goods under treatment, also according to atmospheric conditions, and to the particular method of stuffing employed. The operation of mixing hard and soft ingredients in winter is much more difficult than in hot summer weather. The dubbin for hand-stuffing consists ordinarily of tallow and cod oil, which are mixed together and subjected to heat until the whole of the tallow has become liquefied. The mixing is kept up by stirring, and the harder portions of the fatty matter gradually dissolve into an oil. It is important, in order to make good dubbin, to continue the stirring whilst the mixture is cooling, as otherwise the harder portions of it will crystallise out, and become a crystalline mass, with necessarily therefore, separation of the oil particles. The mixture when cool, should be, throughout, of the consistency of butter or salve, and, also throughout, of uniform consistency.

§1088. In applying the dubbin particular care must be taken to brush it thickly over the hardest and thickest parts of the leather, the thinner parts and the flanks must however be less heavily covered. In some cases a coating of dubbin is given to the grain side of the leather as well as to the flesh side.

§1089. After the application of the dubbin, the leather is hung up in a moderately warm room and *slowly* dried. Most of the tallow in the dubbin-mixture remains on the surface of the leather after the goods have become quite dry. But though taken up only in small proportion by the leather, the proportion depending largely upon the hardness or softness of the tallow itself, and tallows differ considerably in this respect, the ingredient is useful in that it makes the dubbin pasty, so that it adheres to the surface of the leather when applied. The tallow that is left on the surface of the dried leather and goes by the name of table-grease, is scraped off, and utilised usually in a further making of dubbin.

§1090. The drying of the stuffed leather needs careful attention. It should be so regulated as to keep the dubbin in soft condition, and should be slow for the reason that ample time is then given for a full absorption of grease by the leather. If the drying goes on too quickly, the oil in it will dry out before a due absorption of grease has had time to take place.

§1091. It is of particular importance before commencing a stuffing that the leather should be clean. A leather which has particles of wet sumach or of other tanning material adhering to the flesh side of it will not take the stuffing properly.

§1092. DRUM-STUFFING:— The drum method of stuffing has completely revolutionised the manufacture of most of the classes of curried leather, and it is now universal with the dressing of such goods as wax calf, wax kips, satin-grain, etc. In the case of harness leather, and of the other heavy leathers however, the older method of stuffing by hand is still kept to by many manufacturers.

§1093. The preparation of goods to be drum-stuffed is very similar to their preparation when to be hand-stuffed. The goods having been retanned if necessary, scoured, and well brushed to free them from adhering sumach and dirt, should be preferably dried out until completely dry. The goods should now look perfectly bright and clean, both on flesh and grain sides; and they may if desired be kept in this dry condition until the stuffing is to be forthwith proceeded with. Before starting the stuffing, the goods are damped by dipping in a tub of water at a temperature of 40° C. (140° F.), particular care being taken that the goods do not become too wet. After damping, the leather should be laid in pile for at least 12 hours, in order to thoroughly equalise the moisture. The pile should be covered over with wet sacking, or what is preferable, a tarpaulin-sheet, to prevent the outside edges of the pile from drying; this is particularly important in warm summer weather. After samming in this way, each piece of leather should be examined, and any dry spots in it should be damped by mop or sponge; in addition to this the thinner

portions of the leather, such as the flanks, should be made thoroughly wet.

§1094. Too great an amount of attention to the damping cannot be given, for if the leather goes into the drum too wet or too dry the result will be anything but satisfactory. An examination of the leather in the course of its drying after being stuffed will show whether the damping has been properly seen to. If the goods are drying a good level colour throughout, the damping has been done very efficiently; on the other hand, if the colour is irregular in shade, sufficient attention has not been paid

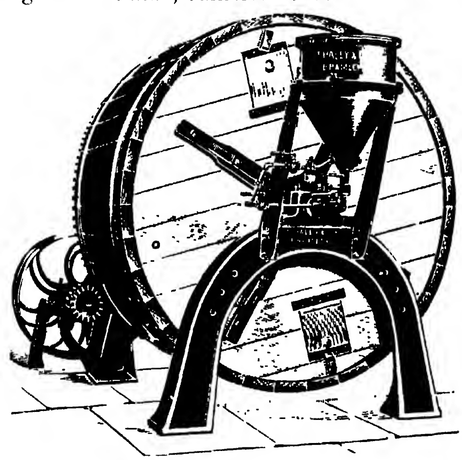


Fig. 188.

to the damping and sammying operations. Even to the non-technical reader it will be evident that the portions of leather which are most damp will take least of the stuffing, the water acting as a resistant to the penetration of the grease. And if the leather has been made too wet throughout, it will not gain sufficiently in weight, because of the inadequate absorption by it of the dubbin mixture. The proper degree of dampness is therefore of very material moment, and is entirely a matter for the judgment of the operator (§1086). The leather when doubled over upon itself and then redoubled, should when pressed between the fingers show a slight trace of moisture oozing out from the pores of the leather.

§1095. The operation of drum-stuffing may be performed in a drum such as described in Chapter IV. for use in dyeing. Or it may be carried through in one of the more up-to-date hot-air stuffing-drums (Figs. 189 and 190), or in the ordinary stuffing drum (Fig. 188).

§1096. When the ordinary dyeing-drum is made use of, then before the introduction of the leather into it, steam is blown in through the hollow axle of the drum for a sufficient length of time to heat the drum to the desired temperature. This heating takes usually about half-an-hour. If the drum has a hot-air attachment, then instead of steam being passed into the vessel, hot air takes the place of the steam.

§1097. The condensed steam must be run-off from the drum before entering the goods. The steaming of the drum will have liquefied the grease, if any, adherent to the vessel inside, and it will be found floating in the condensed water. The water should be run into a tub, when the grease will separate from the water and solidify on its surface and can be re-used. The removal of the condensed water is important, for if it is not removed before the goods are entered into the drum, the goods, absorbing the water, will be rendered too damp for their effective stuffing. Also any steam remaining in the drum must be allowed to escape before entering the goods.

§1098. When the inside of the drum has been heated to a temperature of 60° C. (140° F.), the leather, in its suitable condition of samminess, is entered. If the temperature named is exceeded, there is a liability of serious damage to the goods, as the leather will shrink, and perhaps be burnt. Any shrinkage of the leather will cause the fibres to contract, and the grease cannot then penetrate them properly.

§1099. As soon as the goods are warmed through by being tumbled for a few minutes in the rotating drum, the melted fats are run into it by means of its hollow axle. The drumming is kept up until practically the whole of the grease has been absorbed by the leather. Usually half-an-hour's drumming is sufficient to attain this end.

§1100. The three essential conditions of a successful drum-stuffing are (1) the proper proportioning of the ingredients of the stuffing mixture, (2) the state of the goods in respect to samminess, and (3) the temperature of the drum.

§1101. If the goods happened when entered to be slightly too damp, an additional 10 to 20 minutes' drumming should be given to them. When the stuffing has been properly performed, very little indeed of the stuffing-mixture will remain on the surface of the leather. The quantity of leather that can be stuffed at one time necessarily depends upon the size of the drum employed. From 250 lbs. to 500 lbs. is the maximum quantity to treat at one load; but the nature of the leather to be stuffed, and its thickness, must be taken into consideration.

§1102. After the absorption of the grease, the goods as a rule are gradually cooled down, without their removal from the drum. If the drum has been heated by steam, the ordinary close-fitting door of the drum is replaced by a latticed door, or by a galvanized grating, and rotation given to the drum for the cooling of the goods; in the case of a hot-air drum, a current of cold air is sucked through it. When the goods have been cooled sufficiently, they are removed from the drum, and then set out on the table.

§1103. Mention has been made just above to the heating of the drum by means of hot air; this heating is carried out as follows. The goods are placed in the dry drum, the door is then closed, and rotation of the drum is started. After a few minutes' drumming of the goods, in order to allow the leather to get well opened out, the circulating fan shown in the illustration Fig. 189 is started, and air, heated by passing it through a coil of steam pipes, is blown, by the fan, upon and amidst the leather. The operation is continued until a thermometer placed in the current of hot air from the drum back again to the heater shows a temperature of from 110° to 140°, according to the temperature that has been decided upon as suitable for the goods under treatment. The quicker the temperature is raised to the required point, the better for the goods. By a quick heating the moisture

in the leather is retained, but if the goods are drummed for too long a period before the proper heat is attained, the moisture is drummed out of the leather and the hot air dries it up, and the results are not nearly so good as when the heating is rapidly effected. The heating of the drum with its leather will take from 15 to 20 minutes according to the quantity of the leather and its

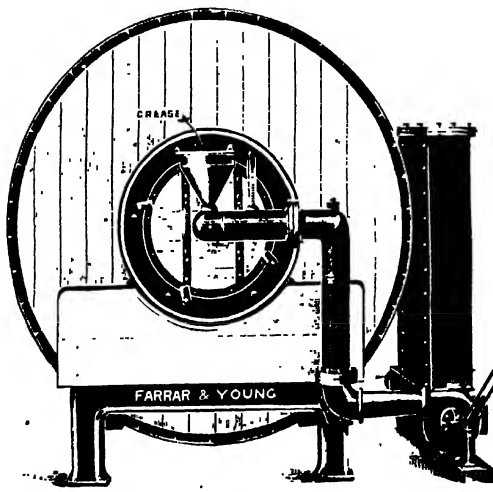


Fig. 189.

condition, and to the size of the drum and the temperature to be attained. When the required temperature is reached, the stuffing-mixture is run in through the hollow axle of the drum. Complete impregnation of the leather by the grease will be effected in about from 15 to 20 minutes, the actual length of time that the drumming must be maintained will depend upon the condition of the leather, and the temperature of the grease and of the drum, and has of necessity to be found out by experience. After the sufficient drumming, the air-valve that is part of the fan is removed, the supply of hot air being thus cut off, and cold air is blown into the vessel; also the door of the drum may be removed and replaced by a grating, as mentioned above where the heating was by steam.

§1104. Comparing the methods of stuffing by hand and stuffing by drum, the essential difference between them is obvious. In the case of hand-stuffing, only those ingredients of the dubbin that are semi-liquid at the temperature of the room in which the leather is dried, can possibly be absorbed, for as stated (§§1082, 1090), it is in the drying-room that the absorption mainly takes place. In the case of drum-stuffing however, the absorption of the grease by the goods is mainly in the heated drum, and it is possible

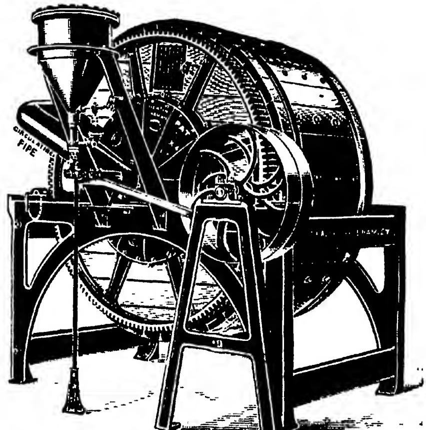


Fig. 190.

consequently by drum-stuffing, to make use of greases of very high melting-points; and possible therefore to considerably increase the weight of the leather without rendering it unduly greasy. The pioneers of stuffing-by-drum were the American curriers, and, making use of the method, a gain of 100 per cent. and more in the weight of the stuffed leather over its weight when dry before stuffing, is often obtained.

§1105. The goods when removed from the drum after cooling should have absorbed the whole of the stuffing mixture. If the whole of the grease has not been absorbed, this points to the goods having been in too wet a condition when placed in the drum. In the subsequent drying of the goods, if the flanks of a skin dry a rather darker colour than its butt and thicker portions, this

shows that the thinner portions have not been damp enough. American curriers carry the samming of their leathers much further than English curriers are in the habit of doing, stuffing them when they are somewhat dry; this probably accounts for the greater weight of grease that the American curriers get into their leathers.

§1106. A further advantage of the drum-stuffing process over that by hand, is that by drum-stuffing the leather can be saturated with harder greases than by hand-stuffing, and that the flanks and thin portions of the leather thus get filled up and rendered firm.

§1107. The proportions of the ingredients of the stuffing-mixture or dubbin for drum-stuffing vary, and vary considerably too, according to the fancies of the operators as well as according to the class of leather that is being dressed, and other conditions above already mentioned. It is partly because of the difference of English and American ways of working, and partly perhaps because of expertness specially cultivated, that the American curried leathers contain more grease than do the English, and especially is this the case with waxed leathers.

§1108. The stuffing ingredients that are mostly used in drum-stuffing are the wool stearins (§1041), recovered or 'Yorkshire' grease (§1042), the paraffins (§1066), tallow (§1038), cod oil (§1044), and sometimes dégras and sod oil (§1048); the addition of a small proportion of resin, usually in the form of Venice-turpentine, is sometimes made in order to enable the leather to carry more stuffing without feeling excessively greasy.

§1109. The following may be taken as typical examples of the proportions of the ingredients of the stuffing mixtures employed in America, and for each example the percentage is given of the permeation of the leather.

CALF SKINS FOR WAX.—

60 per cent. Stearin.
25 per cent. Hard Tallow.
15 per cent. Wool Fat.

Saturation from 75 to 80 per cent. on the dry weight of the leather.

WAX SPLITS.—

80 per cent. Wool Fat.
20 per cent. Hard Tallow.

Saturation 50 per cent. on the dry weight of the leather.

GLOVE GRAIN.—

60 per cent. Hard Tallow.
20 per cent. Stearin.
20 per cent. Wool Fat.

Saturation 40 per cent. on the dry weight of the leather.

§1110. The following are typical examples of the proportions of the ingredients used in stuffing wax leathers, as adopted by English curriers.

WAX CALF.—

65 per cent. Stearin.
15 per cent. Dégras.
20 per cent. Cod Oil.

Saturation from 35 to 40 per cent. on the dry weight of the leather.

WAX KIPS.—

50 per cent. Stearin.
10 per cent. Paraffin Wax.
20 per cent. Cod Oil.
20 per cent. Wool Grease.

Saturation from 30 to 40 per cent. on the dry weight of the leather.

§1111. After drum-stuffing the goods should be immediately well set out ('canked') on the flesh side, and worked with a stone on the grain side; this should be done whilst the goods are still warm.

§1112. The American currier is usually provided with a large galvanized bin, placed near his table, and the goods are placed in this bin on coming from the stuffing drum, the workman removing the leathers piece by piece as he requires them for setting. By this simple precaution the goods are kept in good

condition for the operation and are not exposed to the air, an exposure which is sometimes apt to cause stains, owing to oxidation of the grease on the leather surface.

§1113. When the goods have been set, they are either laid up in pile, or they are hung up, until in suitable condition for a re-setting. If the goods are laid up in pile, care must be taken that they do not heat-up whilst thus left. When ready for the operation, the goods are re-set, which is ordinarily done by stoning the grain, the marks left by the stone being afterwards removed, and the goods finally worked over on the grain surface with a slicker of thin steel.

§1114. 'BURNING-IN.'—Another method of stuffing, which is practised in Germany, is that of 'Burning-In.' The method is largely made use of in stuffing belting-leathers, black-harness leathers, etc. The goods to be treated must be thoroughly and unmistakeably dry; and must not contain even that amount of moisture, small though it apparently may be, (12 to 14 per cent.), that is ordinarily present in air-dried goods. After the air-drying of the goods, they must be further dried-off in a stove the temperature of which should not be less than 45° C., (113°F.), until indeed they are absolutely free from moisture. If the goods are subjected to the burning-in process whilst still containing the moisture usually present in air-dried leather, this moisture will be heated during the process to a temperature that is liable to do serious injury to the leather, in the direction of making it tender by a scorching of its fibres; the rationale of the burning-in process being that whereas whilst water at a temperature from 80°—100° C. (176°—212° F.) will do serious injury to leather, a stuffing mixture of oil and tallow at that temperature will do the leather no injury, providing that the leather is absolutely dry.

§1115. The process is as follows. The goods to be treated are laid, flesh side up, on a frame made of wooden laths, which frame is fitted over a trough that is usually zinc or lead-lined. The stuffing mixture, made ready beforehand by

heating in a steam-jacketed pan to a temperature of 85°—90° C. (185°—194° F.), is applied to the flesh side of the leather, usually by pouring from a ladle, and is then rapidly brushed over its surface. The operation must be carried out in a very hot room, a room heated to 40°—45° C. (104°—113° F.), as otherwise the leather, being itself at a temperature less than that of the melting-point of the stuffing mixture, would solidify the fats applied to them before these had penetrated the leather. Two workmen should conduct the operation, working on the same piece of leather, one of them applying the grease, and the other brushing it rapidly in. Before the application of the stuffing mixture it is customary to wipe over the grain surface of the leather with a sponge or cloth damped in water. This is necessary in order to prevent the grease from penetrating right through the leather to the grain side, such penetration being liable to somewhat darken the colour of the leather and render the colour uneven.

§1116. It is usual to go twice over the goods with the dubbin mixture, the second application being to the thicker parts only of the leather, the thinner parts, the flanks, receiving no second application. After their treatment as above, the hides are placed in a tank filled with water at a temperature of 50°C., (122°F.) in which they are allowed to remain until they are soaked, say from 15 to 20 minutes; they are then, in their wet condition, transferred to the drum, and undergo about half-an-hour's drumming. On being removed from the drum they are laid in pile for several days, until they are in condition to set; or they may be sammed by hanging up, and be afterwards stoned and set.

§1117. Already it has been stated that the burning-in method of stuffing is adapted to heavy leathers, such as are to be used for belting, black-harness, etc. Writing for practical men, it was hardly necessary to say this. The method is suitable for goods that are to be eventually blacked, and for stuffing leathers that are to be applied to what may be called common purposes, such as leather hose, buckets, pump-leathers, etc., purposes in which colour is not of primary importance.

§1118. Stuffing by 'Dipping.'—Yet another method of stuffing which has been lately introduced with success, is known as the 'dipping' process; the method is an improved method of burning-in. The goods after their preparation for stuffing and their preliminary air-drying, are thoroughly dried in the stove (§683), as already described in respect of the burning-in method. In the description of that process, emphasis was laid on the necessity of ridding the goods of all moisture before the actual burning-in of the stuffing. Important however as it is with that process to get rid of all moisture from the goods that are being treated, it is even more imperative to free them from any the least dampness when the dipping method of stuffing is resorted to.

§1119. The initial cost of the process is somewhat heavy. A tank large enough to take the hides when these are suspended one at a time in the tank, preferably suspended by the butt end, is the first requirement. Then some suitable means must be provided for heating the tank, either gas-jets, or a coil of steam pipe at the bottom of the vessel, or, best of all, having the tank steam-jacketed.

§1120. The process is this. First the ingredients of the dubbin are placed in the tank and melted, the temperature being carefully regulated to about 80°C. (170°F.), to a few degrees higher than the melting-point of the mixed greases, and then piece by piece the leathers are lowered into the melted fat. Numerous bubbles immediately arise to the surface of the grease-bath on the introduction of a piece of leather, the bubbling being occasioned by the air which is displaced from the leather by the melted grease, and which rises as it escapes. Immediately the bubbling ceases, the leather may be removed; an immersion of but a few minutes in the melted greases, from 3 to 5 minutes, being all-sufficient. As each piece of leather is removed from its grease-bath, it is pulled on to a sloping board, the board being arranged so that the superfluous grease shall drain back into the tank, is wiped over on both sides with cotton waste or other suitable cleanser, and then immediately plunged into tepid water and allowed to soak

for about half-an-hour. On removal from the water the leathers are laid in pile; they are then softened by placing them in water at a temperature of about 50° C. (120° F.), and finally drummed whilst in their damp condition.

§1121. For both the burning-in method of stuffing and for the dipping method, the stuffing employed is usually a mixture of hard tallow, stearin, and paraffin wax, the proportions of the ingredients being varied according to the leather that is being treated, and to the result that is desired.

§1122. Curried goods are finished for a large variety of purposes; various of these have been already mentioned; harness, belting, wax-calf, kips, satin-grain, memel, glove grain, etc.

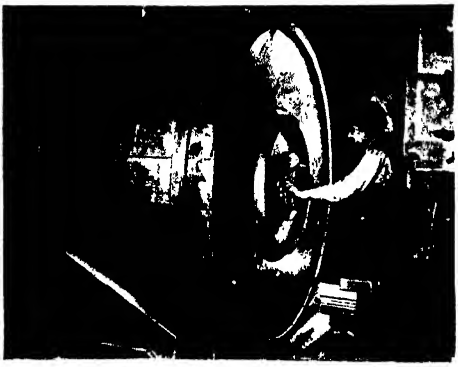


Fig. 191.

CHAPTER XXVIII.

Buffing, Whitening and Blacking.

§1123. Buffing. — The operation of buffing, which has generally been regarded as one of the most difficult operations of the currier's art, has in very great measure, like the operation of shaving, had its place taken by the machine (see §§97, 789; also Chapter XVI., on 'Fluffing.') Buffing consists in the removal of the grain surface of the leather. The currier's slicker is the tool by which the removal is effected when the buffing is done by hand. The illustration Fig. 192 shows a skin which is being thus buffed. The currier's slicker consists of a steel knife or blade, generally about 5 ins. by $5\frac{1}{4}$ ins., fitted into a thin

Fig. 192.

wooden handle. The knife is prepared for use by being keenly sharpened on the clearing stone (Fig. 22, and §§76-79) and by

the edge being *very slightly* turned by means of a thin steel bodkin (seen in Fig. 192, also Fig. 26), the turn-up being so slight that the wire-edge is essentially a continuation of the ground-edge. This edge the workman keeps always sharp (see §§87, 88). The slicker being kept as flat to the leather as possible during the operation, the workman, with slicing strokes of the tool removes the grain-surface. The stroke of the slicker may be described as a cunning or ' canny ' one, and much practice is needed to acquire dexterity in it.

§1124. WHITENING.—This operation, when done by hand is like to that of buffing by hand, except that the removal of surface is on the flesh side of the leather.

§1125. A type of machine that is applicable to whitening and more or less to buffing, is shown in the illustration Fig. 193.

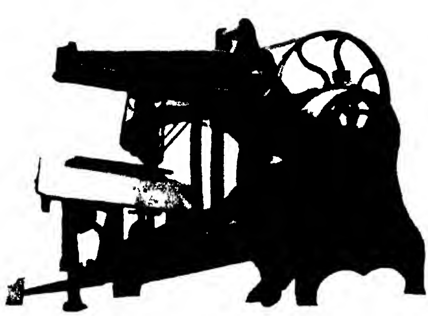


Fig. 193.

The machine has a many-bladed knife (similar to that of a shaving machine, see Fig. 31), which rotates rapidly, and the blades of which are kept keenly-edged by the traverse across them of a thin emery-grinder which also rotates, its rotation being in the opposite direction to that of the knife-cylinder. The knife, together with its traversing-grinder, has movement of reciprocation in the direction of the length of the table upon which the skin under treatment is placed. The table itself is leather-covered, and the skin that is being whitened is brought up to the rotating-knife by the foot-lever seen in the illustration.

§1126. Blacking.—The blacking of leather has of late years been largely done by machine, particularly of side leathers, *e.g.*, box kip, and curried leathers; shoulders, etc. The first machine introduced into England for this above purpose was the Batcheler

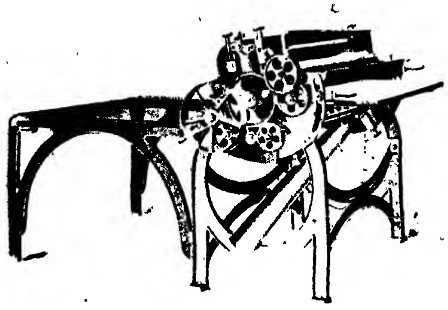


Fig. 194.

machine, some 15 or 16 years ago. An improved form of it is illustrated in Fig. 194. The machine met with success at that time in

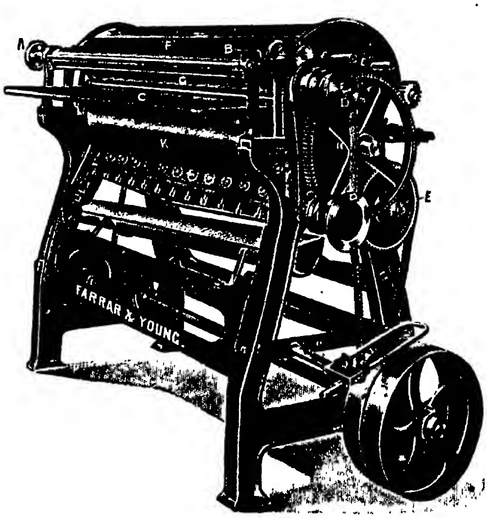


Fig. 195.

America, in the blacking of waxed leathers, but it was not very successful here in England. Its non-success in this country

came chiefly about in that the blacking used in the mahcine by the English curriers was one that was not suitable for the machine. The oil-black and lamp-black made use of by English curriers for hand blacking in those days would not properly feed the machine; whereas the more viscous soap-blacking universally employed by American curriers was very suitable for it. Of late years the machine has been considerably improved, particularly as regards the feeding and distribution of the blacking, and now the operation can be performed with even a thin and watery black, such for example as an ink of logwood and iron. The improvements in the machine have considerably increased its utility, and it is now possible to black practically any leather by it.

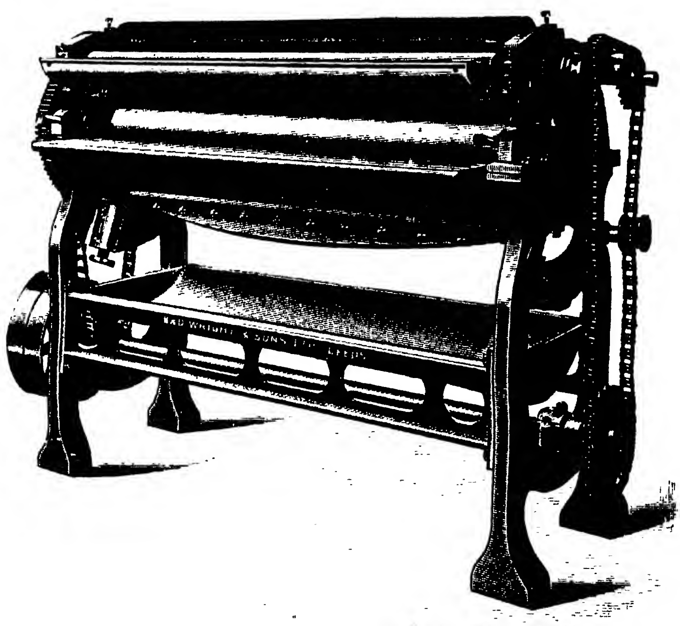


Fig. 196.

§1127. The skin that is operated upon passes from the table at the front end of the machine between a copper-drum and a rotating brush. The ink or blacking is fed from a pan filled with

it, to the revolving brush, by means of a corrugated-brass roller which rotates in the ink-pan, and the ink is applied by the brush to the skin. The brush in the rear (see the Fig., which shows an end of both front and rear brushes) rubs and brushes the black well into the leather, the skin after that passing on to the string-covered table (see the Fig.), from which it is removed and carried away to be dried. The speeds of the copper roller, brush, and the ink-feeding roller may be varied by means of change-gears, so that any desired quantity of the fluid-black may be applied to the skins under treatment. The brushes can also be changed and their pressure on the skins varied to suit any particular kind of work. In some makes of the machine the blacking is situate at the side of it; in other makes it is placed on the top; the latter position is generally to be preferred.

§1128. Another type of blacking machine recently introduced is represented in Figs. 196, 197. For this machine various advantages are claimed.

§1129. Essentially the machine consists of 5 rollers. The largest, A, of these is a copper roller, and has its bearings in the lower portion of the machine side-frames. The other rollers B, C, D, and E, are carried in the upper portion of the frames. The directions in which the several rollers turn are indicated by arrows. The skins to be blacked are placed, one at a time, on the table F, in front of the machine. The ink trough or pan is shown at G. The roller B is of brass, fluted. The rollers C and D are the circular revolving brushes. The roller E is of wood covered with felt.

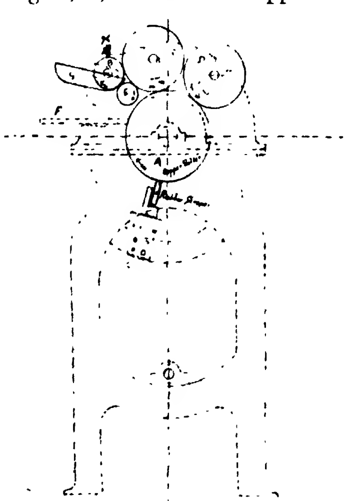


Fig. 197.

§1130. When the machine is in action and a skin is placed on the table F and in touch with the roller A, it is carried over that roller. The fluted roller, B, takes-up ink out of the trough G, and deposits it on the roller-brush C, and it is brushed on to the skin as this passes over A. The second roller-brush D takes its ink from C, as well as wipes up any surplus ink on C, and helps to brush the ink into the skin. It will be seen from the Fig. that the inner edge of the ink pan is carried up high, so that any ink that drops from the roller B is received back into the pan and cannot drop on to a skin. The felt-covered roller E fits close up to the ink trough, and gathers up any ink that may run over the edge of the pan. The rubber-scraper H (see top roller B), equalises the ink-deposit upon the brush C. The copper roller A has a rubber scraper (see the Fig. 197), which keeps it perfectly clean, so that there may be no smear of ink on the under-side of a skin. The skin as it comes over the roller A is received by a workman at the back of the machine.

CHAPTER XXIX.

CURRYING OF WAXED LEATHERS, HARNESS, AND SATIN.

§1131. WAXED LEATHERS.—The leathers that go by the name of Waxed Leathers are finished on the flesh side. Why they bear this appellation is somewhat doubtful. Presumably they got the name by reason of the facts that the sizes that are used in the finishing operations of such leathers invariably have wax as one of their ingredients, and that, commonly, these finishing operations are termed 'waxing'; the transfer of the term from the leather underfinish to the leather when actually finished was easy.

§1132. The goods that are to become waxed leathers are shaved and scoured as already has been described (§§62, 104). In the better class of such goods it is still customary with some curriers to shave the goods by hand. As experts, they contend that owing to the pulling and stretching that the skins go through when being shaved by machine, the goods do not finish up so well, particularly as regards the flanks.

§1133. Waxed calf and kips are now invariably drum-stuffed. In England, usually, the stuffing mixture (§1109) is composed of stearin and sod oil, with the addition sometimes of wool grease and cod oil (*see* §§1042, 1044). The goods, whilst still warm after their stuffing, are first set (§598) by working the grain well out; after this they are worked on the flesh side ('canked'); finally they are well glassed on the grain side. Then the goods are dried, and when dry they are usually ready for whitening. Some curriers prefer to lay the goods in pile for several days before proceeding with the whitening operation, the contention being that by such procedure the goods become mellowed and more matured. The goods, before laying in pile are very often "rounded" as it is termed; the 'rounding' consists in applying a thin coat of dubbin and water to the grain side, making the application to the lighter

coloured portion of the grain only, the object being to make the grain side an even colour all over its surface.

§1134. The skins after lying in pile are usually first brushed over with a solution of soft soap in water, 3ozs. to 4ozs. of soap to 3 gallons of water, and they are then ready for whitening. The whitening is done with a turned slicker (§1124); and, once more, we have an expert operation, the whitening being a matter of manipulation that requires great care. The whitening should only be carried to the point of obtaining a fine flesh surface on which to finish with the waxing. Of necessity all marks and scratches on the leather must be removed; also veins. Before further procedure all dirt and grease that may be adhering to the goods is slicked off.

§1135. After the whitening of the goods they are grained. The graining is done with the arm board (§836), working of course on the flesh side, first from one of the shanks to the opposite shank, then reversing, and then graining from neck to butt, care being particularly taken during the graining not to break up the flanks.

§1136. The skins are now ready for waxing, and the first operation of the waxing is the blacking of the goods. On first-class goods this operation is invariably done by hand. The blacking machine (§1126) however, when manipulated with intelligence, turns out good work.

§1137. When the blacking is done by hand the currier has the choice of two sorts of blacking, the older and more common blacking being the 'lampblack and oil' mixture, and the more recent one being the 'soap' blacking.

§1138. Here are two examples.

Soap Blacking.	Lampblack and Oil Blacking.
1 lb. Soap.	1½ to 2 lbs. Lampblack.
½ lb Lampblack.	1 gallon Cod Oil.
4 ozs. Logwood Extract.	
1 gallon Water.	
Dissolve Logwoood Extract and Soap in water before adding the Lampblack.	

§1139. After the blacking of the goods, the flesh side is we glassed up, and the skins are then hung up to dry. When dry the are mostly oiled over with cod oil; this done they are ready fo sizing. Goods that have been blacked with the soap blacking ar usually only once sized; the following is a typical size for th purpose.

Add 4 ozs. Logwood Extract.
1½ lbs. Glue.
½ lb. Soap.
To 1 gallon of water and allow to soak over night, dissolv by steaming and add 4 ozs. Beeswax, 2 oz Burgundy Pitch, 8 ozs. Tallow, 2 pints Linseed Oi Steam up together until dissolved and stir up for som time, afterwards allow to set.

§1140. On the other hand, if the goods have been blacked wit the lampblack and oil mixture, they are sized twice; the firs sizing being called the bottom sizing, and the after sizing the to sizing. The goods are dried between the sizings. Examples o the composition of bottom and top sizes here follow.

Bottom Size.	Top Size.
1½ lbs. Glue.	2 lbs. Glue.
1½ lbs. Soap.	2 pints Cod Oil.
2 ozs. Logwood Extract.	2 ozs. Nigrosine.
1 gallon Water.	½ lb. Tallow.
	4 ozs. Beeswax.
	2 ozs. Venice Turpentine.
	½ gallon Water.

After sizing the goods are usually padded off by rubbing over wit a soft leather pad in order to remove brush marks and are the hung up to dry.

§1141. Currying of Black Harness Leather.—The goods a received are first sorted, and the best in grain and colour, selecte for dressing into brown harness (§1151).

§1142. The goods for black finish are first rounded and weighe after which they are soaked ready for shaving, they are then cu

down the ridge into backs. Each pair of backs is usually marked at this stage with a number, each back being marked with the same number, and during the operation of dressing the backs are kept in these pairs. Before shaving, jacking (§26) is to be recommended. The goods are now shaved; this operation being invariably performed by hand, over the beam (§§63-89). A few manufacturers, particularly abroad, split the goods on a splitting machine (§§28-61), flatting them afterwards on the shaving machine (§§90-103). If the goods are rather thick in the neck, it is an advantage to run them through the Union splitter (§30) before shaving, in order to take down the substance somewhat at the thick part, and lessen the amount of labour. After the goods have been shaved they are scoured, and this operation which is

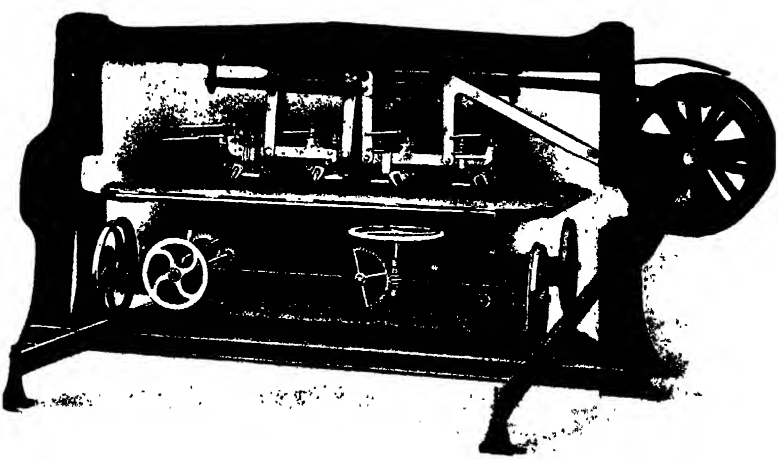


Fig. 198.

invariably done by machine, either the Jackson type of machine (§109), or the newly introduced Vavasour machine Fig. 198, being used for the purpose; though here again the operation is very often performed entirely by hand, even in some of the most up-to-date factories in this country. After a thorough scouring the goods are generally re-tanned with sumach in order to brighten up the colour. The re-tanning, or "vatting," as it is termed, is done by immerson in a strong solution of sumach liquor.

Drumming in sumach is seldom the method employed on this class of leather. After sumaching, the goods are well slicked over, then usually oiled with cod-oil on the grain side, and afterwards hung up in the drying shed until sammed. When in a somewhat highly-sammed condition, the goods are stoned out on the grain side, the operation usually being done by machine, though still in some works the stoning is by hand. After stoning, the goods are flatted over the beam, a smaller knife being used than is generally used for shaving, it being essential that the operation should be expertly done.

§1143. The stuffing of best quality harness is still a hand-operation, though some few manufacturers are now employing the drum for the purpose, and still others the method of dipping (§1118). For stuffing, when this is done by hand, the mixture made use of consists generally of pure cod-oil and tallow dubbin (§1087). The goods, after the application of the dubbin to the flesh side, and a smear of it on the grain side, are hung up until sufficiently dry for re-setting, which is performed after all dry places have been damped with water; finally the goods are hung up until quite dry. When the leather has been stuffed by dipping or by drum, the setting is generally done by machine. After the re-setting and drying, any defective or coarse grain is removed by buffing with a whitening slicker (§1123); the backs are then ready for blacking.

§1144. In England the blacking is almost entirely done by hand. The goods are first of all brushed over with a solution of washing soda or ammonia, in order to free the grain from grease sufficiently to allow the logwood and iron solutions, the application of which next follows, to reach the surface of the leather. The soda or ammonia solution should be the weakest possible; considerable damage done to the grain of curried leathers has been traced to the use of too strong a solution of either of these alkalies (§399). Usually ½ lb. of washing soda or 5 ozs. (by measure) of ammonia, in 3 gallons of water, gives a sufficiently strong solution for the purpose mentioned. After the application of the alkaline solution, the goods are brushed over with a logwood infusion. A

better application is that of a logwood-fustic solution (§400); 5 lbs. of logwood extract, and 1 lb. fustic extract, in 10 gallons of water. Finally the goods are treated with a solution of iron; 5 lbs. copperas (iron sulphate) and ½ lb. bluestone (copper sulphate), in 10 gallons of water (§400).

§1145. A word of caution is necessary here against the dangerous practice of blacking with commercially-prepared inks without the previous preparation of the leather with logwood. These inks are chiefly solutions of iron to which a small proportion of logwood, of nut-galls, or of some black coal-tar dyestuff, has been added, along with shellac (§762), dextrine, or glucose, and other matters oftentimes, too numerous to make mention of, and these inks are for the most part applied to the leather in their full strength. One of the chief causes of cracky grain in harness, and other such black leathers, is the application to them, by means of the inks, of a too strong solution of iron (§401).

§1146. After the application of the solution of iron, it is advisable to brush the leather over with water to get rid of any excess of iron solution, or better still, to again brush it over with the logwood-fustic solution that was applied previous to the application of the iron. A little dubbin is then generally rubbed into the grain surface of the leather and the goods are hung up to dry. When dry the flesh side of the leather is slicked over to remove grease; sometimes it is slicker-whitened. After the slicking-off of the grease, or after the whitening, as the case may be, the flesh is well glassed, the operation being usually performed by hand, though a glassing by machine might very well take the place of the hand operation.

§1147. The application of a solution of gum tragacanth (§752), 1 oz. to 1 gallon of water, or of Irish moss (§739), ¼ lb. to the gallon of water, or of algin (§741), 1 lb. to the gallon of water, to the flesh side of the leather before glassing is advantageous, as securing the production of a nice, smooth, flesh side.

§1148. Any excess of grease on the grain side is now removed with a slicker, and the grain having been well cleaned by first a

brushing over with a stiff brush, and then a rubbing over with a cloth, the goods are well glassed on the grain side. Finally a little 'buck tallow' is applied to the grain. Buck tallow, the name indicates it, is tallow prepared from the fat of the buck-deer. As this however is somewhat difficult to procure, the currier, as a substitute for it, makes a mixture of paraffin-wax, tallow, and spermaceti, varying the proportions of the ingredients to suit his particular requirements.

§1149. As an example of such mixture the following may be taken :—

Tallow	3 parts.
Paraffin Wax	1 part.
Spermaceti	½ part.

The ingredients are melted together and allowed to cool ; when cold the mixture is ready for use.

§1150. After the application of the buck-tallow, or its substitute, the goods again undergo brushing, and are then finally glassed-off.

§1151. Brown Harness.—Brown harness is finished in much the same way as black harness, the blacking operation being of course omitted. The flesh side is treated with buck-tallow and then well brushed and glassed. The grain side is brushed over with soft tallow, which is well rubbed into the leather by the hand. The goods are then hung up for a short time, and finally, just as with black harness-leather, are brushed and glassed.

§1152. Dressing of Satin Leather.—The dressing of hides for satin is now-a-days very seldom gone through ; a good number of hide-bellies, however, are still dressed for this finish. A few shoulders are also thus dressed.

§1153. The goods are first soaked ready for shaving (§19) or splitting (§19), the hide or belly being split to the substance required. The flesh side of kips is generally used for waxing; the flesh split of hide bellies is commonly sized with glue, and, after shaving, used for stiffeners and in soleing shoes. The goods after being split are scoured, being however first preferably drummed in a weak solution of washing soda or borax, the scouring

being done either by hand, or by machine of the Burdon type (§109). After the scouring, which is not nearly so important an operation on this class of leather, which is to be blacked, as upon leather which is to be coloured, the goods are sammed, either by hanging-up or passing through the squeezing machine (§§643 and 1084), they are then ready for stuffing. The stuffing operation is invariably performed by the drum method. The amount of stuffing given to this class of leather is generally about from 40 to 50 per cent. on the weight of dry leather. The operation is performed as described in §1092. After the stuffing the goods, while still warm, are set. The setting of hides and kips is most commonly done by machine; bellies and shoulders however being done by hand. The goods are now hung up to dry. When dry the goods are ready for buffing. The buffing may be done on the whitening machine (§1125), or by hand with the whitening slicker. After a light buffing the goods are blacked, for which operation they are set down, in order to keep the flesh clean, on a table which has been thinly rubbed over with soft tallow. They are then first brushed over on the grain side with a logwood solution (§1144), afterwards lightly set out with the slicker, and then immediately brushed over with a solution of iron (§1144); finally the goods are brushed over on the grain side with oil. The oil generally used is a mixture of cod and mineral oil. After being oiled, the goods are well set-out on the table with a sharp slicker, and afterwards lightly glassed, and then finally sized over. The composition of size-mixtures varies. The size is well brushed into the grain-surface of the leather, which is then rubbed over with a chamois-leather pad. After bottom-sizing in this way the goods are generally whitened, and then top-sized with brush and pad as before. The leather finally is dried, glassed, and oiled over with the above oil-mixture.

CHAPTER XXX.

Dyeing of Wool Rugs and Furs.

§1154. In the dyeing of skins for wool rugs, it is most essential that the wool should be properly prepared; and my intention therefore is, to devote a considerable space to the preparation of these skins, before proceeding to describe the various methods in use for dyeing them.

§1155. The goods require to be first thoroughly degreased: and this remark applies not only to the skin itself, but to the wool also. If the wool is not thoroughly free from grease, it of course cannot dry properly and evenly; and if the skin has not had removed from it practically the whole of its natural grease, then, besides not tawing properly, and thus not being converted into leather, it is liable to putrefaction, with a loosening of the epidermis, and a consequent loosening of the wool; at the same time the skins give off a somewhat offensive odour, and if laid upon anything that will take stain, will leave upon it a decidedly greasy stain. It is thus obvious that the removal of the grease from the skins must be as complete as possible, and the first thing to do to ensure this removal, is to soak the skins in tepid water. This soaking must be most thorough; apart from the need of it to prepare the goods for scouring, it is necessary in order to remove dirt, adhering dung, blood, etc., and in the case of dry skins to, as nearly as can be, bring them back to their original condition when taken from the animal. The soaking should be in a large tub, in a sufficiency of water at a temperature of about 35°C., (95°F.); and, after a few hours, there should be a complete change of water at the same temperature, and a further few hours soaking of the goods; and then once more a fresh supply of water as before, and a continuation of the soaking.

The goods must be very carefully watched during the soakings, especially in warm weather; otherwise putrefaction will set up, and the wool will consequently loosen. A little carbolic acid may be added to the several waters with advantage.

§1156. After the thorough soaking of the skins as above described, they are ready for scouring. For the scouring, they are taken from the tub and laid, flesh-side up, upon a flat, inclined board. The scouring on the flesh-side is with a mixture of soap and warm water, and the scouring, like the soaking must be thorough. A little caustic soda may be added to the water; the addition greatly facilitates the removal of the grease. A fitting quantity of soap and of caustic soda for use in this flesh-side scouring, is 4 ozs. of soft soap and 1 oz. of good caustic soda per gallon of water.

§1157. When the flesh-side of a skin has been thoroughly scoured, and adhering pieces of flesh and fat removed by scraping with a sharp knife, the skin is turned over, and the wool side is scoured. The scouring is with a mixture of soft soap and warm water, in the proportion of from 1 lb. to 2 lbs. of soap to one gallon of water. The method of the scouring is by hand-rubbing the solution well into the roots of the wool. In this scouring of the wool-side there must be no addition of caustic soda to the water; with such an addition there would be considerable likelihood of doing injury to the fibre of the wool. After these scourings the goods are well washed in water, and then re-scoured, a fresh solution of soft soap and warm water being used for the purpose. This done, the goods are again washed; and the operations described are repeated until the wool is perfectly clean; any thorns or adhering twigs met with during the scourings being of course removed. The wool-sides having been made indisputably clean, the goods must undergo a thorough washing in order to free them from soap. This is best carried out, where there is convenience for such procedure, by placing the goods in a running stream of water. In many works built on the banks of a river, the skins are fastened up to a stake, and allowed to remain in the river-water for some hours. Where this course is not possible, recourse must be had

to washing in several changes of water; in any case the goods should be quite freed from soap.

§1158. The soap having been thoroughly washed out of the skins, they are thrown over a hurdle so that as much water as possible may drain off; they are then transferred to a hydro-extractor.

§1159. HYDRO-EXTRACTOR.—The Hydro-Extractor is an old friend, the Centrifugal Drying Machine—under a new name. There are many different types of the machine, but in principle they are all alike. The machine consists of a box cage, or basket as it is often termed, of strong iron-wire or perforated steel, galvanized, or of perforated copper, shallow in proportion to its diameter, with an outer casing. The inner receptacle is capable of revolution; its dimensions vary from a diameter of about 18 inches for hand power to a diameter of say 7 feet, for steam or electric power. The revolution is horizontal, unless some special reason requires it to be vertical; horizontal because that disposition for it is conducive to steadiness. In the inner receptacle the goods are placed from which the water is to be expelled, and very rapid rotation is then given to the receptacle. The goods, acted upon by centrifugal force, try to escape sideways from the basket. Unable to break prison however, they push forcibly against the periphery of the cage; and the quicker the revolution of the cage the greater is the pressure of the goods against its outer wall. Further outwards the goods cannot go, but the water that is in them can, and this, being squeezed out, flies off first of all in small particles and then as a mist. The machine dries very effectively.

§1160. The goods should be packed evenly all round the receptacle, so that it shall balance as nearly as possible. For inequality of balance shows itself directly rotation is started; and the basket swings or oscillates, and vibration is set up in the whole apparatus. In the steam-engine the eccentric is balanced, as may be seen when taking a steamboat trip, by a special fitting, the eccentric-balance, because of the vibration there would be in the machinery without it. The provision that is made in the

hydro-extractor to control the oscillation of the basket, is that instead of the axis being rigid, some play is allowed to it, so that, under rapid rotation, it shall right itself; as a boy's peg-top does when spinning capriciously, until it finds its *axis of gyration*, and having found it, 'goes to sleep'; this axis of gyration being a vertical line through the peg point on which the top is spinning and the centre of gravity of the top. And similarly with a hydro-extractor, whether its basket is supported from below, or suspended from above (as for example a gas-chandelier is), its axis of gyration, is the vertical line passing through the centre of gravity of the spinning mass, of, that is, the basket and its load. This axis the basket finds for itself; the oscillation that there is on starting rotation, gradually decreasing as speed gets up. The water from the revolving basket is thrown against the sides of the outer casing, down which it trickles, and from which it flows.

§1161. Two illustrations of hydro-extractors, (Figs. 199 and 200), are here shown. The illustration Fig. 199 is of a machine

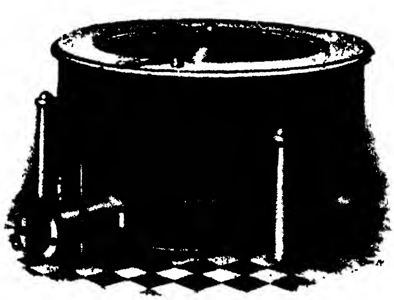


Fig. 199.

constructed by Messrs. Thomas Broadbent & Sons, Ltd., of Huddersfield. The machine is "self-contained"; that is to say, its rotating portion is all in one with a small steam-engine which drives the rotating spindle direct. The machine can therefore be run when the main engine is not working; at any time day or night, which is often a convenience. It can be fixed in small

space, massive foundation is unnecessary, and it quickly attains full speed. The Fig. 200 is an illustration of a machine by Messrs. Watson, Laidlaw & Co., Ld., of Glasgow, which is electrically driven, and of "suspended type." Features claimed for their

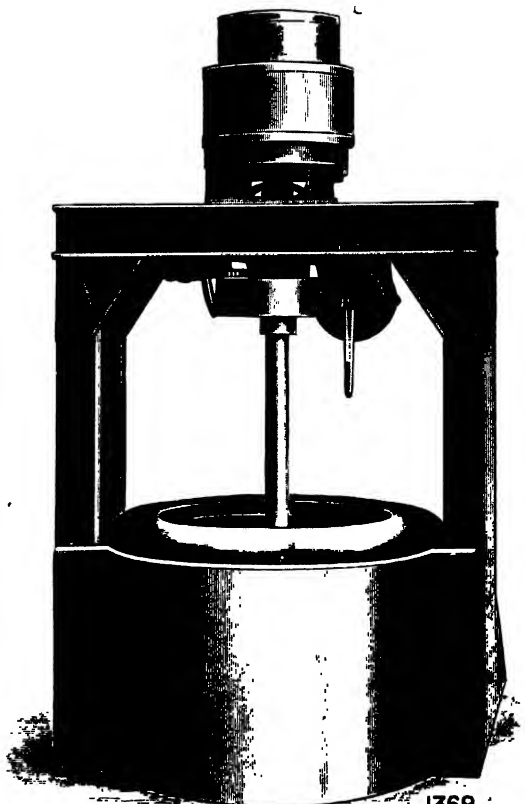


Fig. 200.

machines are that a foundation is not required, as they can be bolted to any floor that will carry ordinary machinery; that the driving gear brings rotation up to full speed gradually; and that the baskets have a capacity greater than is usual. The baskets have a wide lip, turning inwards.

§1162. After the drying by hydro-extractor, they are ready for the tawing or leathering. For this operation the skin is usually laced into a frame, either of the methods shown in Figs. 129, 130 (§§677, 679) being employed, and the flesh-side is painted over with a solution of alum and salt, a suitable proportion being 8 ozs. of alum and 24 ozs. of salt per gallon of water. The solution should be applied warm, at a temperature not exceeding 45°C., (113°F.) however, and well brushed into the skin. This done, the goods are allowed to dry somewhat, and a second application of the solution to the skin is then made.

§1163. The operations that follow the scouring depend upon the colour that the goods are to be dyed. If light shades of colour are required, it will be necessary to bleach the wool. The only satisfactory method of bleaching wool rugs is the sulphur bleach described in a former Chapter, (Chap. II, §§164-172, 177, 178).

§1164. The bleaching is necessary in practically all cases except where very dark shades are required ; as most sheep and goatskins, even after a thorough scouring, are somewhat yellow at the tips of the wool, and especially is this so in the flanks and in the belly portions of the skin. And as this yellow-coloured wool dyes a different shade to the rest of the wool, it is obvious that the bleaching is a necessity. In the case of mats, to be dyed black of course no bleaching is required.

§1165. Degreasing is the first operation after the scouring, its purpose being to remove any grease left after the scouring. The goods are painted over on the flesh-side with a thick mixture of whitening and water, 2 or 3 lbs. of whitening being made up into a paste with about a gallon of water. The application is made with a brush, and care must be taken to apply the paint most thickly to the neck and the butt, where most of the grease is usually present. After the application of the whitening, the goods are dried in a stove, when the grease that remains in the skins will be absorbed by the whitening, and will appear as a dark greasy patch on the white painted surface. If it is necessary the discoloured whitening should be scraped off, a further painting

with the whitening be made, and the drying repeated. When the whole of the grease has been removed, the skins are ready for chloring (§174).

§1166. The chloring is performed by immersing the wool for a short time in a $\frac{1}{2}°$ Twaddle solution of bleaching powder, and the object of the treatment is to render the wool more susceptible to the dye. The length of time that the goods remain in the bleaching-powder solution differs in almost every manufactory, but generally half-an-hour is quite sufficient, though in some works the goods are allowed to lie in the solution as long as five or six hours. Great care must be taken with this operation, lest the wool fibre should be damaged, of which there is considerable liability. In no case should the strength of the bleaching-powder solution exceed $\frac{1}{2}°$ Twaddle, or the wool may possibly be dissolved and the skin ruined.

§1167. After the chloring, the goods, if intended for colours, require souring (§122). This is best carried out by the use of a weak vitriol solution, the goods, after washing, being placed in the solution. In strength the solution should not exceed from 1 to 2 lbs. of concentrated sulphuric-acid to 40 gallons of water. The skins are left in the solution for a few minutes, and then, after washing in water, they are ready for the dye-bath.

§1168. First of all as to the dyeing of blacks. Just as with leather and with textiles, a good black is more difficult to produce than any other colour. As yet no satisfactory method of dyeing wool mats black with aniline dyes or aniline products has been discovered. It needs to be mentioned however, that it is possible by means of Ursol to produce a fairly satisfactory black. But the black thus obtained has a slightly reddish tone, and this disadvantage is very apparent when the wool is held up to the light. This defect could be got over by first dyeing the wool blue; the cost however at present of this colour practically prohibits its use. A one-solution method of dyeing a wool rug black now follows.

§1169. The dye-bath in this method is prepared by dissolving 10 lbs. of logwood extract, 2 lbs. of fustic extract, and $\frac{1}{2}$ lb. of copper

acetate in 400 gallons of water. The skins being immersed in this solution, are kept in it at a temperature of as near as possible 45° C., (113° F.)., for from three to four hours; 2 lbs. of commercial nitrate of iron are then added, and the skins are allowed to remain in the mixture until they are dyed a good black. The time required to produce the black is generally from 24 to 48 hours.

§1170. It is obvious that this method is a rather expensive one, owing to the considerable length of time that is required; and although a method somewhat similar to this is employed at the present day by the majority of wool-rug dyers, it is evident that a method requiring a much shorter time would mean a considerable saving of capital. The method described however can be considerably accelerated by the employment of a series of vats, in the manner now to be explained.

§1171. Let us suppose that six vats are made use of, these being placed adjoining each other in a single row, and that these vats are supplied with the dyeing ingredients in the quantities here named.

Vats.	Logwood Extract.	Fustic Extract.	Acetate of Copper.	Nitrate of Iron.
1	5 lb.	1 lb.	½ lb.	½ lb.
2	10 „	2 „	1 „	1 „
3	15 „	3 „	1½ „	1½ „
4	20 „	4 „	2 „	2 „
5	25 „	5 „	3 „	3 „
6	30 „	10 „	5 „	5 „

Pack No. 1 of Rugs is now placed in Vat No. 1, and is allowed to remain there for two hours. The pack is then transferred to Vat No. 2, and Pack No. 2 of goods is placed in Vat No. 1. The two packs now remain in their respective baths for two hours. The two packs are then transferred, Pack No. 1 to Vat No. 3, and Pack No. 2 to Vat No. 2. Vat No. 1 is now again empty; being

empty, Pack No. 3 is placed in it. We now have Pack No. 3 in Vat No. 1, Pack No. 2 in Vat No. 2, and Pack No. 1 in Vat No. 3. Transfer is now made of each of the packs to the vat in advance of it, and Pack No. 4 is entered into Vat No. 1, which has become empty of goods. And so on successively, until in Vat No. 1 the No. 6 Pack is placed; Pack No. 5 being in Vat No. 2, Pack No. 4 in Vat No. 3, Pack No. 3 in Vat No. 4, Pack No. 2 in Vat No. 5, and Pack No. 1 in Vat No. 6; Vat No. 6 being the Finishing Vat; and two hours being allowed to elapse between each transfer of goods.

§1172. At the next transfer of the packs, No. 1 Pack comes away from No. 6 Vat altogether; the pack has attained a sufficient depth of colour. The Vat No. 6 liquor too has become reduced in strength, whilst that of Vat No. 1 is exhausted. Instead therefore of entering Pack No. 7 in Vat No. 1, the solution that remains in the vat is thrown away, and into the Vat No. 1 a fresh solution is supplied, of the full strength of the solution that at the first was placed in Vat No. 6, (see §1171), made up, that is to say, of its several ingredients in the quantities respectively of 30 lbs., 10 lbs., 5 lbs., and 5 lbs. Previously Vat No. 6 was the Finishing Vat, but now the Finishing Vat is Vat No. 1. This vat takes as it were the place of Vat No. 6; Vat No. 6 becomes Vat No. 5; Vat No. 5 becomes Vat No. 4, and so on; Vat No. 2 becoming Vat No. 1.

§1173. The table below shows what takes place.

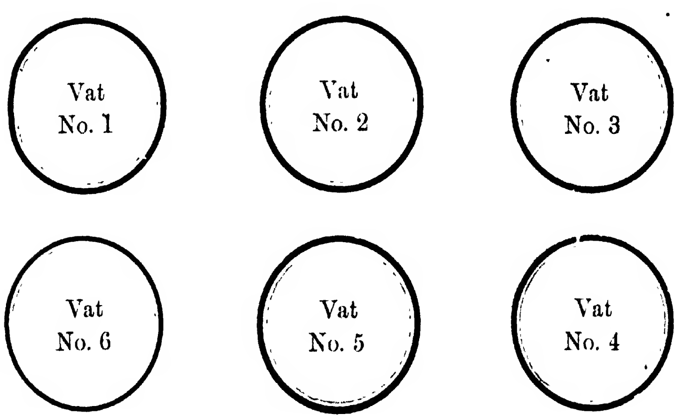
THE ENTERING VAT IS THAT OF THE WEAKEST LIQUOR; THE FINISHING VAT IS THAT OF THE STRONGEST LIQUOR.

Vats.	Liquors at Start of Dyeing.	Liquors after First Six Transfers of Packs.	Liquors after Second Six Transfers of Packs.	Liquors after Third Six Transfers of Packs.	Liquors after Fourth Six Transfers of Packs.	Liquors after Fifth Six Transfers of Packs.
1	ENTERING VAT	FINISHING VAT	5th Strength Liquor	4th Strength Liquor	3rd Strength Liquor	2nd Strength Liquor
2	2nd Strength Liquor	ENTERING VAT	FINISHING VAT	5th Strength Liquor	4th Strength Liquor	3rd Strength Liquor
3	3rd Strength Liquor	2nd Strength Liquor	ENTERING VAT	FINISHING VAT	5th Strength Liquor	4th Strength Liquor
4	4th Strength Liquor	3rd Strength Liquor	2nd Strength Liquor	ENTERING VAT	FINISHING VAT	5th Strength Liquor
5	5th Strength Liquor	4th Strength Liquor	3rd Strength Liquor	2nd Strength Liquor	ENTERING VAT	FINISHING VAT
6	FINISHING VAT	5th Strength Liquor	4th Strength Liquor	3rd Strength Liquor	2nd Strength Liquor	ENTERING VAT

After the Sixth of 6-transfers of goods from vat to vat, the then throwing away the Entering Vat, (Vat 6) liquor, and the refilling of this vat with liquor of the full strength, this vat becomes again the Finishing Vat, and the six vats are again doing duty, as will be seen from the diagram, exactly as they were at the beginning of the dyeing, and Vat No. 1, which for Pack No. 6 contained 2nd Strength Liquor, contains for Pack No. 7 a liquor of *entering* strength, and becomes the Entering Vat. And this order of working can be followed, no matter how great may be the number of the packs of goods that are to be dyed.

§1174. If the vats instead of being arranged in one line, are arranged in two lines, the working from vat to vat will be just the same, it is simply the arrangement of the vats that has been changed. Their arrangement will be thus:—

Fig. 201.



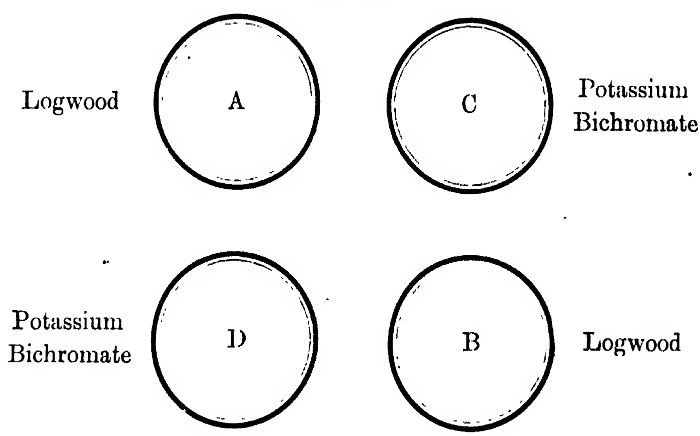
§1175. It will be quite clear that by the method of procedure just described, the length of time necessary in the dyeing is considerably shortened, and as the several liquors at the conclusion of the dyeing are essentially exhausted, it will be also evident that there is a great saving of material upon the older method of placing the goods in one solution until dyed, and then making a fresh solution for the next pack.

§1176. The two-solution method of dyeing wool-rugs black, particularised below, is a much quicker method. The number of vats necessary is four, A, B, C, D, (see diagram p. 432, Fig. 202). The capacity of the vats being 500 gallons each say. The preparation is as follows. In Vat A, 50 lbs. of logwood extract is dissolved, and in Vat B 100 lbs. In Vat C, 5 lbs. of potassium bichromate is dissolved, and in Vat D, 10 lbs. of it. The rugs to be dyed, after the chloring, and having been well washed, are placed in Vat A, and are let remain there about two hours, the solution being kept at a temperature not exceeding 45° C., (113° F.) The goods are now lifted out of the vat, and after draining, are placed in Vat C, in which vat they are allowed to remain 1½ hours, at a temperature not exceeding 35° C., (95° F.). Now again they are lifted and drained, and then passed into Vat B, where they remain two hours, the solution being kept at a temperature of 45° C. Finally they are removed from Vat B, drained, and immersed in Vat D, kept at a temperature of 35° C., and in Vat D, they remain until their colour is satisfactorily black, which will be the case generally in about one to two hours.

§1177. To dye a 2nd pack of goods it will be necessary to make two further solutions only. By the passage of the goods through Vats B and D the solutions these vats contained have been considerably weakened, and the solutions are now of about the same strength as were the solutions originally placed in Vats A and C. The Vats B and D therefore become Vats A and C for the 2nd pack of goods. Entered into Vat B, the goods remain there for the time stated above, about two hours, and are then removed, drained, and passed into Vat D. In the meantime the solutions of Vats A and C have been replenished, a solution of 100 lbs. of logwood extract having been prepared for Vat A, and a solution of 10 lbs. of potassium bichromate for Vat C, and these two vats now become Vats B and D for the 2nd pack; remaining in the logwood solution for about two hours, and in the potassium bichromate solution from one to two hours, the temperatures of the solutions and the draining of the goods being just the same as for the 1st pack.

§1178. By the passage of the 2nd pack of goods through the strong solutions in Vats A and C, the solutions have become weakened, and the 3rd pack of goods pass through these two vats for their 1st and 2nd steepings. Whilst the soaking goes on, Vats B and D have been supplied with fresh solutions, Vat B with a solution of 100 lbs. of logwood extract, and Vat D with a solution of 10 lbs. of bichromate of potash. For a 4th pack of goods Vats A and C will receive fresh solutions, and the working of the pack through the vats will be the same as the working was of the 2nd pack.

Fig. 202.



	1st Logwood Immersion.	1st Potassium Bichromate Immersion.	2nd Logwood Immersion.	2nd Potassium Bichromate Immersion.
1st Pack of goods	Vat A	Vat C	Vat B	Vat D
2nd „ „	Vat B	Vat D	Vat A	Vat C
3rd „ „	Vat A	Vat C	Vat B	Vat D
4th „ „	Vat B	Vat D	Vat A	Vat C

§1179. This two-solution method of dyeing the rugs black is an exceedingly quick one, and it produces an excellent black. The goods after dyeing are allowed to drain, and are rinsed in warm water; they are then scoured with soft soap and water, washed, and dried after draining in the hydro-extractor. Their final drying is in a hot drying-room. Before the final drying the alum and salt that has been washed out of the goods in the dyeing process must be replaced by painting the mats over, on the flesh-side, with a fresh alum-and-salt solution, (§1162). When dry the goods are softened by drumming in a wire cage.

§1180. The finished goods should have a bright gloss on them. Most manufacturers rely, for the production of this gloss, upon the scouring of the goods after dyeing; the writer however has obtained an excellent gloss upon wool mats by subjecting them, after dyeing and washing, to a fat-liquor, such as is used with chrome and various other leathers, and particulars of which will be found in previous chapters.

§1181. The fat-liquor, which consists of a mixture of soap and oil thoroughly emulsified, is placed in a vat, and the goods, after being allowed to drain from the washing, are drawn through the fat-liquor twice, and thrown over a hurdle and allowed to drain from the fat-liquoring. They then are treated with the hydro-extractor and dried. It will be found that this fat-liquoring operation produces an excellent gloss upon the wool; it fixes the black moreover, which is greatly improved by the operation.

§1182. COLOURED WOOL RUGS.—Before dyeing the rugs, it is necessary when light shades of colour are required, to first bleach the wool, as mentioned above. It is also necessary, no matter what colour is required, to treat the wool in a solution of bleaching-powder. This is best done by placing the goods in a solution of about ½ a degree, Twaddle strength, of the powder, for from one to two hours, the solution being at a temperature of from 25° to 30° C., (77° to 86° F.); then washing the goods free

from the bleaching-powder, and passing them through a weak sour made of vitriol, and finally, previous to the dyeing, washing them free from the vitriol in water.

§1183. The great difficulty in the dyeing of wool mats in colour, is that the wool has very little attraction for aniline dyestuffs, when these are applied at the comparatively low temperature that is necessary in order that no injury may be done to the leather to which the wool is attached.

§1184. It was a common plan some years ago to dye wool mats singly, and to apply the dyestuff at the temperature of boiling water. This operation was carried out by placing the skin in a frame (§§677, 679) and carefully lowering the skin, wool downwards, into the vat containing the dyestuff solution, *cold*, until the wool was completely immersed in the liquor, the leather remaining above the surface of the dyestuff solution. Then the dye-bath was heated to nearly boiling point, and the skin remained suspended in the bath until the wool had acquired the desired depth of shade.

§1185. Putting aside the fact that with this procedure a vat was needed for every skin to be dyed, it is obvious that in carrying out the operation there is considerable danger of the destruction of the leather by its coming into contact with so hot a solution, of its being 'cooked,' as it is termed. On the other hand, if the wool was not immersed in dyestuff up to its roots, it was not dyed up to its roots, and an undyed portion of the wool showed when the mat was finished; a defect greatly objected to by buyers of these goods.

§1186. The plan that is now most generally adopted is to dye the mats at a temperature not exceeding 45° C., (113° F.); this being the highest temperature that the leather will comfortably stand without injury, and to immerse the whole of the mat into the dyestuff liquor. Those dyestuffs have had to be resorted to therefore, that have a great affinity for wool fibre; the basic colours being those most suitable for the purpose.

§1187. Amongst the most suitable Basic dyes may be mentioned —Safranines, Bismark Browns, Vesuvines, Magentas, Chrysoidines, Methylene Blues, Methylene Greens, Malachite Greens, Methyl Violets, etc.

§1188. The basic dyes unfortunately possess a tendency to rub and to dye the tips of the wool a much deeper colour than the body. This latter may be lessened slightly by adding a little acetic acid and Glauber's salt to the dyebath, and the tendency to rub can be overcome by passing the goods through a suitable tannin solution after well washing. Any of the following tanning materials can be employed:—Cutch, Sumach, Hemlock, and Chestnut or Quebracho Extract. The goods can also be dyed by first bottoming with a natural dyewood (p. 144), followed by a metallic mordant (p. 156), and then dyeing with a basic dye. By this method very fast shades are produced.

§1189. A good commercial yellowish brown and one which strikes evenly and quickly can be obtained by using 2 oz. of any of the aforementioned tanning materials for each pair of skins, immersing for half an hour, allowing to drain and then immersing in potassium titanium oxalate, 1 oz. per pair. A suitable amount of basic dye is 1 oz. per pair, together with the addition of ½ oz. acetic acid and 4 oz. Glauber's salt.

FOR YELLOWISH GREEN:—1 part of Methylene Blue or Green, 2 to 3 parts Auramine.

BRILLIANT GREEN:—15 parts Auramine, 1 part Methylene Green.

SAGE GREEN:—1 part Methylene Green, ¼ part Chrysoidine.

DARK GREEN:—15 parts Auramine, 5 parts Methylene Green, 5 parts Chrysoidine.

GOLD:—1 part Auramine, 1/10th part Bismark Brown.

BROWN:—1 part Bismark Brown, 1 part Auramine, 1/12th part Methylene Blue.

Dark Blue:—First treat as for Blacks as described above, and to then dye in Methylene Blue.

Crimson:—1 part Safranine, ¼ part Auramine.

Red:—Russia Red alone, or with Chrysoidine.

After dyeing until the required shade is produced, the skins are well washed, drained, hydro-extracted, retanned if necessary, dried, and finally trimmed.

§1190. Dyeing with Acid Colours.—When acid colours are employed, an amount of sulphuric acid equal to about half the weight of the dyestuff is added to the dyebath, together with four times that quantity of Glauber's salt. Formic acid is to be specially recommended for use with acid colours. One or two ounces of dye per pair of skins is used, according to the depth of shade required.

Reds:—Almost the whole of the Fast Reds are suitable, and a good commercial shade can be produced by using ½ oz. of Fast Red and ½ oz. Azo Fuchsine.

Golden Brown:—6 parts Acid Brown, 1 part Naphthylamine Black.

Gold:—8 parts Old Gold G, 3 parts Quinoline Yellow.

Sage Green:—8 parts Naphthol Green, 12 parts Quinoline Yellow, 1 part Acid Brown, developing the colour by passing the skin through a weak solution of copperas after dyeing.

Electric Blue:—1 oz. per pair of Alkalie Blue, and 1 oz. washing soda. Dye for half an hour, lift, and develop the blue colour in a weak, cold vitriol bath. If the latter bath be warm redder shades are produced.

Silver Grey:—Equal parts of Silver Grey N and acetic acid.

Russet Brown:—12 parts Acid Brown, 3 parts Naphthol Green, 2 parts Acid Green. Lift and pass into a weak copperas bath.

A large number of shades can also be produced by the use of Picric acid, such as bright yellows, brilliant greens, scarlets, old golds, &c., in admixture with suitable acid colours.

§1191. A common plan is to ground the wool first with a dye-wood extract. For instance; in dyeing Bronze Green the goods are first worked in a solution of Fustic Extract to which is added a little alum, and when dyed a bright yellow colour, a little Methylene Green and Bismark Brown is added to the dyebaths, and the dyeing continued until the required shade and depth of colour is obtained.

§1192. After the dyeing, the goods are washed in warm water, being finally dried, and lightly retanned with alum and salt, as above described.

The Dyeing of Furs.

§1193. Our book would not be complete if it omitted the subject of the dyeing of fur-skins. Up to quite recently the dyeing of fur-skins was a secret process in the hands of one or two firms. The dyeing was generally accomplished by means of chemical mordants; iron sulphate, potassium bichromate, copper sulphate, for instance, in combination with pyrogallic acid and a few natural dyestuffs. With the introduction of 'ursol' colours however, the dyeing of furs has been considerably simplified; the shades of colour produced moreover, are no doubt much superior to those produced by the older-fashioned method of dyeing, and a much greater variety of shades is attainable.

§1194. The 'ursols' are not colouring matters in the true sense of the word, but *oxidations*; colours that is to say that develop on the fur fibre by the use of such oxidising agents as ferric chloride, potassium permanganate, bichromate, hydrogen peroxide, etc. The brands in most common use are Ursols P, D, DB, and 2G.

§1195. Ursols D and DB produce blacks; the former a dark black, the latter a blue black. Ursols P and 2G are used in the production of browns; from yellowish brown to dark brown being produced by the 2G brand, and reddish or foxey brown by the P brand.

§1196. Generally speaking there are two methods of dyeing furs; (1) by immersion of the entire fur-skin in the dye-bath; and (2) by the process generally known as tipping; that is simply brushing the dyestuff on the fur.

§1197. When treating furs which possess much natural grease, it is necessary previous to the dyeing operation to subject the skins to a treatment, commonly called 'killing,' with lime, or a mixture of lime and washing-soda solution, in order to overcome the grease and render the hair more susceptible to the dye. The killing process is easily carried out, by brushing the skins over on the fur side with a mixture of 8 ozs. slaked lime, 4 ozs. iron sulphate, and 2½ ozs. alum, dissolved in 1 gallon water. After their brushing over with the above mixture, the goods are allowed to dry without washing; being however finally well washed for mordanting.

§1198. For some classes of skins washing-soda solution of 9° Twaddle strength is to be recommended; and in the case of very greasy skins a weak caustic-soda solution may be employed. If the goods are not subjected to the killing operation, they must be well washed in a strong solution of soap, to which a little washing-soda may be added with advantage.

§1199. Mordanting of Fur-skins.—The following are the mordants generally employed when the skins are to be dyed brown shades. Chrome mordant: ½ oz. potassium bichromate, oz. tartar, and 20 grains copper sulphate, per gallon of water.

§1200. For grey and black shades: ⅛ to 1 oz. of copper sulphate per gallon of water, or ⅛ to 1 oz. of ferrous sulphate dissolved in 1 gallon of water.

§1201. The goods are floated in the mordanting solution at a temperature of 38° C. (100° F.). The period of immersion depends

upon the class of skins, but an average time would be 2 hours; the goods being then removed, drained, and well rinsed in cold water; when they are ready for dyeing.

§1202. The dyeing process varies according to the shade of colour that is to be produced and the class of skin being treated. Generally however the goods are immersed in the dyeing solution for a period of at least 3 hours. The time is extended to as long a period as 24 hours with some kinds of goods. Almost every species of fur-skin is dyed, from the cheap rabbit, or Thibet-sheep skin, to the more expensive seal-fur. A few typical formulæ which have been tested and found to give good results are appended.

§1203. A brown sable is dyed on a long-haired rabbit-skin after first brushing it over with a caustic-soda solution at a strength of 3° Twaddle, and mordanting it for 3 hours in a solution of ⅛ oz. copper sulphate per gallon of water, with a bath of 34 grains ursol D, 30 grains ursol P, 27 grains ursol 2G, 15 grains pyrogallic acid, and 4½ oz. hydrogen peroxide, per gallon of water.

§1204. In carrying out the process it is to be recommended to add one-half of the prepared ursol solution to the dye-bath to commence with, immersing the goods for 1 or 2 hours, and then to add the hydrogen-peroxide solution and continue the immersion for another 1 or 2 hours, and finally to add the remainder of the dissolved ursol mixture. During the dyeing the goods should be worked occasionally to prevent any liability to unevenness of colour.

§1205. Hare-skins.—In order to produce on a common class skin a good imitation of a better and more expensive fur it is very often the custom to first dye the goods a ground-colour, and afterwards to dye the fur-tips another colour, by brushing the fur over with a solution of the same ground-colour, or of another dyestuff. An example on a hare-skin is that of a dark reddish-brown ground-colour tipped with a dark brownish-black.

§1206. The skins having been prepared by a brushing-over with the lime and iron mixture recommended above, are mor-

danted for 6 hours with the chrome-mordant, and then dyed with 40 grains ursol D, 96 grains ursol P, 20 grains pyrogallic acid, and 6½ oz. hydrogen peroxide, per gallon of water; the skins being immersed for 6 hours, then dried, and afterwards tipped with 3¼ oz. ursol D, and 4 lb. hydrogen peroxide, per gallon of water.

§1207. A black may be produced on Thibet-sheep skins by first mordanting for 12 hours with 1 oz. copper sulphate per gallon of water, and then dyeing with ¾ oz. ursol D, 40 grains ursol DB, and 1 lb. hydrogen peroxide, per gallon of water: prolonging the process over 24 hours.

§1208. A good black can be produced on hare skins, after killing the grease with the above lime and iron mixture, in the same way as that sketched-out for Thibet-sheep.

§1209. Marmot skins are largely dyed for imitation-sable. A good sable-brown can be produced as follows:—

§1210. The grease in the skin is first killed with the above lime and iron mixture; it is then bleached by immersion in a solution of hydrogen peroxide, made by mixing an equal part of water with an equal part of hydogen-peroxide solution, and afterwards dyed with 90 grains ursol D, 15 grains ursol P, 40 grains pyrogallic acid, 55 grains ammonia, and 6½ oz. hydrogen peroxide, in 1 gallon water, the dyeing being continued for 3 hours, and the skins being finally tipped with ½ oz. ursol D, ⅖ oz. ursol P, ⅖ oz. pyrogallic acid, ⅘ oz. ammonia, and 26 oz. hydrogen peroxide, per gallon water.

§1211. Shorn rabbit makes a cheap imitation-seal. This may be dyed after mordanting for 6 hours with a chrome mordant with ⅖ oz. ursol P, 40 grains ursol D, ⅖ oz. ammonia, and 10 oz. hydrogen peroxide, the dyeing being continued for 4 hours, and the skins being afterwards tipped with 4⅓ oz. ursol D, ½ oz. ursol DB, and 6 lbs. hydrogen peroxide, per gallon of water.

§1212. Musk-rat is largely dyed for a better-class imitation-seal. The skins are first mordanted with a chrome mordant, and afterwards dyed with ⅖ oz. ursol P, 40 grains pyrogallic acid,

½ oz. ammonia, and 10 oz. hydrogen peroxide, per gallon of water, immersing the skins in the dye-bath for 6 hours, and afterwards tipping with 4½ oz. ursol D, ½ oz. ursol DB, and 6 lbs. hydrogen peroxide.

§1213. After dyeing, the skins are usually dried in a hydro-extractor, (Figs. 199, 200) and then brushed over on the flesh side with a mixture of common salt, egg yolk, and glycerine; in the proportions of 1 lb. glycerine, ¾ lb. preserved egg-yolk, and 2 lbs. common salt, in a gallon of tepid water. After the application of this mixture the goods are dried, usually being nailed, strained-tightly, on boards.

§1214. When dry the skins are softened by tumbling in a wire cage, and the requisite polish is imparted to the hair by a further tumbling in a dry drum (Fig. 64,) with the addition of hot fine-sand: the drumming being continued for 1 or 2 hours, or until the fur is sufficiently well polished.

CHAPTER XXXI.

Dyestuff Comparisons; and the Testing of Dyestuffs.

§1215. It should be held as a duty by every leather trades' chemist and leather dyer to test every consignment of dyestuff that is delivered at his particular works. And he should also be able to ascertain whether, for the special requirements of the works, the cheapest dye that is in the market, (not necessarily the lowest in price) is being obtained.

§1216. Considerable saving may often be effected in the purchase of dyes. Many examples of uneconomical purchase have come under the writer's notice. It is quite a common occurrence for a leather manufacturer and dyer to be using a dye which costs 6/- or 7/- per lb., for which another dye might be substituted, costing perhaps not more than from 1/3 to 1/6 per lb., that would answer the required purpose equally well. It is a bit surprising, in these days of the fine-cutting of profits, that so little attention is paid in the factories to the dyes used, and their qualities, prices, and strengths. There are many manufactories that still employ that very expensive dyestuff, pure Phosphine, paying for it as high a price as 12/- or 14/- per lb., for which other dyestuffs recently placed upon the market and costing not more than one-quarter the price of the pure article, might advantageously be substituted, such as Para-Phosphine, Cori-Phosphine, Philadelphia Yellow, etc., dyes which produce on the leather a similar shade to that produced by the pure Phosphine.

§1217. By a judicious mixture of various dyestuffs, it is possible, as pointed out in Chapter VIII., on Colour and Colour-Matching, to produce practically every conceivable shade of colour; and the dyestuffs that are necessary need not number more than about half-a-dozen.

§1218. It does not follow, as stated just above, that a dye, say Fast Red at 8d. per lb. for example, as made by one house, is cheaper than another maker's sample of the same colour at 1/- per lb. In these days of keen competition on the part of many of the aniline-dye manufacturers, they are, some of them quite ready to quote practically any price for a dyestuff, and in order to do this, they adulterate largely with either dextrine or sugar. The writer knows of several cases where there has been a reduction of as much as 50% on the price of a dyestuff, but there has been also a 50% reduction in the colour. And the matter often resolves itself into paying 2/- per lb. for dextrine instead of 4d. The amount of colour in a sample of dye cannot be judged by the weight, and it is quite evident therefore that each batch of dyestuffs should be tested, and the amount of colour in the dyestuffs ascertained. There is no doubt that if the testing of dyestuffs as received were the recognised practice, the deliveries of dyestuff made to the leather dyer would be more uniform and the addition of the various foreign matters such as dextrine, sodium sulphate, common salt, etc., would not be necessary and would to a very large extent be abandoned.

§1219. In order to test the dyeing-power of any particular dyestuff, equal weights of the material to be dyed, or in the case of leather, pieces of the same superficial area, are dyed with quantities *equal in cost* of the several dyestuffs to be examined; the sample which gives the best colour and the deepest shade of it being of course the cheapest of the stuffs, no matter what the actual price may be.

§1220. To carry out comparative trials of dyestuffs upon leather, some convenient apparatus is necessary. The apparatus, whatever it may be, must fulfil the conditions of being capable of dyeing say six pieces of equal area, at the same time preferably but certainly at the same temperature, and with equal quantities of liquor in the dye-baths.

§1221. I have found the apparatus shown in Fig. 204, which was, I believe, originally designed by Professor Hummel, a very useful one for the dyestuff-trials. It consists of six battery jars, or

dimensions about 4 ins. by 2 ins. and 6 ins. deep each, placed side by side in a copper vessel. Let us suppose that six samples of Bismark Brown are to be tested, A, B, C, D, E, F, costing respectively 1/8, 1/10, 2/-, 2/4, 2/6 and 3/- per lb. First six pieces of sumach-tanned skiver, carefully cut each to the size 3-in. by 8-in., are letter-punched with the letters just above stated, and these are prepared for dyeing by a soaking in water for 15 minutes at a temperature of 45° to 50° C., (113°-122° F.). The soaking can be very conveniently done in an enamelled-iron pie-dish.

Fig. 203.

§1222. The leathers after their soaking are struck-out on a piece of plate-glass with a vulcanite slicker, Fig. 203, a hole is stabbed through each corner of each piece, and each piece is folded on itself, corners to corners, grain side outwards. A hook of copper or silver wire is now passed through each corner, the hooks being so fashioned that the leathers can hang, each in its own jar, from a piece of glass rod resting on the ends of each jar; and a piece of glass rod is placed in the fold of each piece of leather, to weight it so that it shall hang evenly in its jar and entirely immersed. In the Fig. 204 is an illustration of a single jar with a leather hanging in it, showing the hooks with the method of their attachment, and the two pieces of glass rod. The six jars, each equipped as explained, are next placed side by side in the copper vessel, which is of such dimensions that it will easily hold the

jars, and will also allow water to freely circulate around and between the jars; a thermometer is fitted centrally at one side of the copper vessel, and a gas burner underneath it.

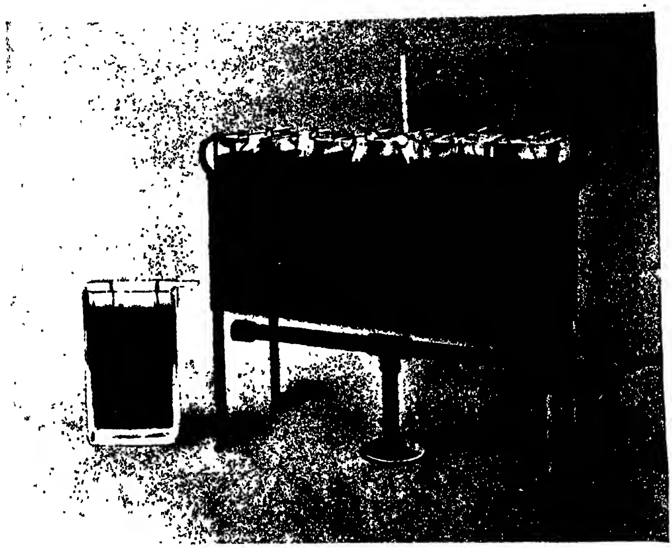


Fig. 204.

§1223. In the meantime a solution is prepared of 1 gramme of tartar emetic and 4 grammes of salt for each bath, the quantities mentioned being accurately weighed-out. The purpose of the solution is the fixing of the tanning in an insoluble form in the leather, previous to the dyeing. With this solution the jars are now filled. The larger of the illustrations of Fig. 204 shows the arrangement in its entirety; the jars with their leathers and solutions, the thermometer, and the gas burner. A sufficiency of water is placed in the copper vessel, and the heat of the water and solutions is raised to between 45° and 50°C., (113°-122°F.) This temperature is kept up for half-an-hour, the leathers being occasionally lifted by means of the glass rods during that time.

§1224. After the fixing operation, the leathers are taken out of the jars, the jars are emptied, and the leathers are washed in water at the same above temperature, so as to remove the tartar emetic

and salt in them. The washing may be conveniently done in the enamelled dish previously mentioned (§1221). In order to ensure complete removal of the tartar emetic and salt, it is advisable to carry out the washing in two or three changes of water. The leathers when thoroughly washed, are struck out on a glass plate, and again attached to the copper or silver hooks and weighted with the pieces of glass rod; this done the leathers are ready for their further treatment.

§1225. Now, equivalent *money-values*, which must not be greater in amount than 0.2 grammes of the six dyestuffs to be tested are carefully weighed out upon an accurate chemical balance

Fig. 205.

into six porcelain basins (see Fig. 205), these being marked from A to F so as to correspond with the dyestuffs, and the basins are filled with boiling water in order to dissolve the dyestuffs. When the dyestuffs are wholly dissolved, the contents of the basins are transferred to the glass jars; the contents of basin A to the jar containing the piece of leather marked A, the contents of basin B to the jar containing the leather marked B, and so on with the

whole 6 basins and 6 leathers. The jars are now again placed in the copper vessel, and are filled up with clean water, the quantities of the dyestuff-solutions being thus equalized throughout, and the temperature is raised to and kept at from 45° to 50°C. for one hour. The leathers require occasional movement during the hour, and especially during the first quarter of it. At the expiration of the hour the leathers are removed from the jars, washed in warm water, carefully struck out on both flesh and grain sides, and strained on a board, each piece with four nails,

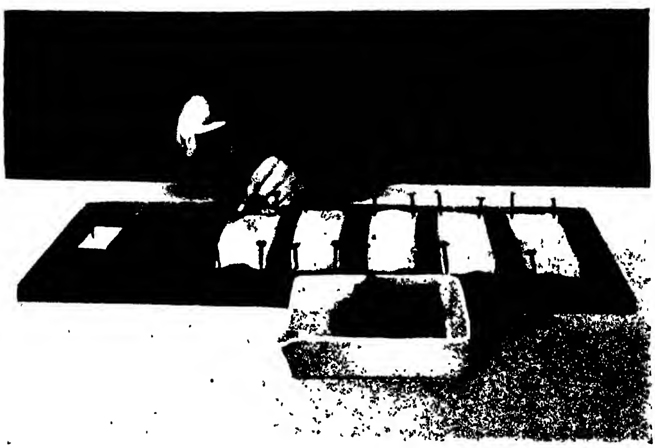


Fig. 206.

one at each corner, as shown in Fig. 206 and then carefully dried in a room at a temperature not exceeding 20° C. (68° F.) It is evident that the pattern which, when dry, is the fullest in its shade of colour, is the cheapest of the dyestuffs, no matter what its price per lb. may be. If the colours to be tested are acid colours, the fixing operation with tartar emetic and salt is of course not necessary.

§1226. Where expense is not the main consideration, there may be substituted with advantage, for the above-described appliances, six miniature paddles such as are shown in Fig. 207, made of copper or brass, each paddle having its own compartment. To

prevent any darkening of leathers by impurities in the copper dissolved when employing acid solutions, the inside of the paddle-work should be painted with white bath-enamel. The dimensions that the author has found very suitable for the miniature paddles are these:—length, 9 inches; width, 5½ inches; depth, 5½ inches; capacity, 3 quarts, and the speed at which they should be driven is 24 to 30 revolutions per minute. A small water-motor fitted on the end of a water-tap forms a satisfactory driving-power where other is not available, with a small countershaft to reduce speed.

§1227. The preparation of the pieces of leather that are to be used for the testings is as before; they are soaked and struck out and the tannin in them fixed if the colours are basic. And the dyestuff solutions having been made, they are emptied into the model-paddle, each solution into a compartment by itself; the temperature is raised to 45° C.; the leathers are placed in the

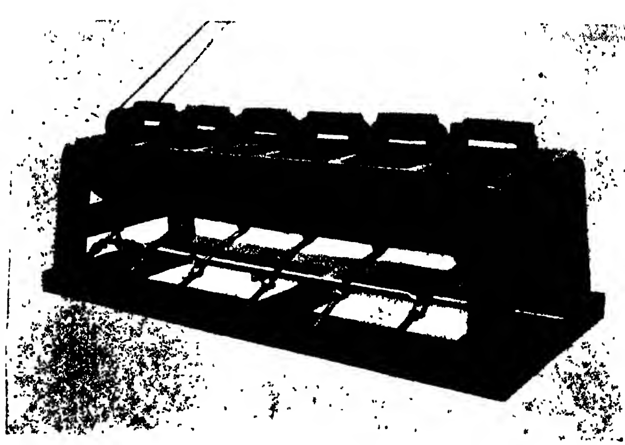


Fig. 207.

paddles, one in each compartment of it; and revolution is started and maintained for three-quarters of an hour. The leathers are then removed, washed, struck out, and dried as before. The leather pieces may be of any size up to say 40 square inches; the

particular point to be attended to being that they must be all of the same size. Experience has shown me that a very convenient size for a paddle of the above-given dimensions is 6 inches by 5, (30 square inches), when the leather made use of is sumach-tanned skiver.

§1228. With either apparatus described, the dyer can try for himself the effects of various additions to the dyebaths; of different preparatory treatment of the leathers used; and of a mixture of dyestuff-colours. He can also work-out shades of colour and combinations of shades of colour on a small scale, and calculate the exact amounts of dyestuffs required in order to produce on a larger scale the shades he desires. If the scale is such that he thinks of employing the drum for his dyeing, another trial-apparatus may be resorted to. This is shown in Fig. 208. The jars now made use of are not battery-jars, but the circular-jars quite commonly employed in storing confectionery; about 9

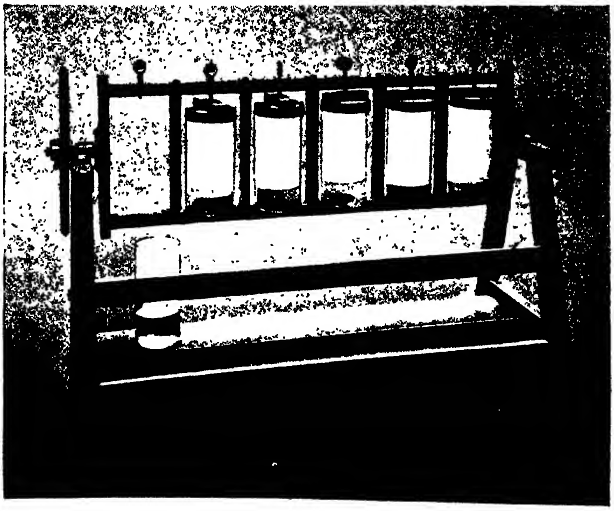


Fig. 208.

inches high and 5 inches in diameter; one jar is shown, detached, in the Fig. It is in these jars that the dyestuff-solutions

are now made; and they are fitted each with a wooden cover, between which and the glass jars a rubber disc is placed. Thus fitted they can be placed upright in a rectangular frame capable of rotation. Fig. 208 shows a framework of this kind; the jars stand on one of its bars, and screws are brought down through the opposite bar on to the covers of the jars. Thus held they are immoveable, and the leathers in them are in continuous movement when rotation of the framework is started; and the jars as now held being moreover water-tight, there is no leakage.

§1229. The Fig. 209 shows a further method of making comparative dye trials on pieces of leather. In this case the dye solution is prepared and placed in an ordinary half-plate photo-

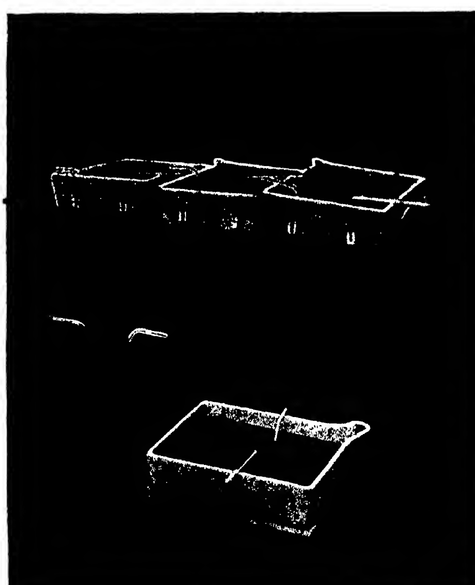


Fig. 209.

graphic dish. The dish and contents are kept to the temperature required during the dyeing process by being placed over the top of a water bath. The leather is laid over a piece of bent glass rod

as is shown at the bottom of the Fig. During the dyeing the piece of leather is moved by an occasional shifting of the position of the rod as it rests on the edge of the dish.

§1230. Still other apparatus for making comparative dye trials are shown in Figs. 210 and 211. Fig. 210 is an apparatus devised by Professor Procter for use in the analysis of tanning

Fig. 210.

materials. It consists of a box containing a number of compartments, each lined with thick felt, and sufficiently large to hold a bottle of convenient size, and the box turns on a horizontal axis. As employed for dyeing trials, the piece of leather to be dyed is placed in the required amount of water at the required temperature, together with the dissolved dyestuff. The bottle is then closed by means of a rubber bung and placed in the box. The bottles, whether one or several, are kept in place by closing the lid of the box. The box can be rotated either by hand, or, as is shown in the illustration, by power.

§1231. The apparatus Fig. 211 is one designed by the writer. It has 6 arms and a central axis. Each arm is provided with a collar which can move through a small distance longitudinally,

and is kept in position by a spring. The bottles are round-shouldered, such as are used in confectionery, and are held in the collars by their necks. Two of the bottles, detached, are seen in the Fig. The bottles are fitted with rubber stoppers.

Fig. 211.

The dyestuff solutions along with the pieces of leather to be dyed, are placed in the machine, the bottles being held firmly in the apparatus by the springs which hold the bottles firmly in place by means of their respective collars, and rotation is started. This may be either by hand, or as shown in the Fig. by power. A violent drumming action is thus obtained. The machine has proved itself of great utility for carrying out comparative dye trials, and it possesses the advantage that it takes up very little space.

§1232. In carrying out a dyeing experiment on one or two skins the small drum illustrated in Fig. 212 is to be recommended. This machine, which is a Bradford-washer, makes a very effective drum for carrying out experiments on a small scale in dyeing.

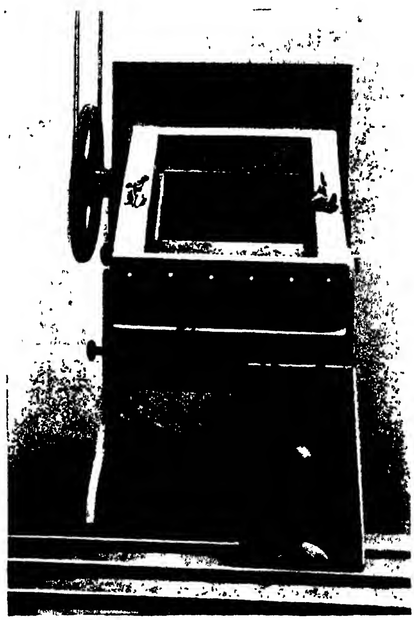


Fig. 212.

§1233. The testing of dyestuffs includes a testing of the fastness to light of the colours they produce. To carry out this test, take half of the dyed and dried pattern, and place it, together with a standard pattern, the fading period of which is known (Appendix B), in a situation where the patterns come under the direct influence of a good light. Only half the pattern is to be thus exposed, the other half being kept carefully covered. Examination of the progress of the fading should be made at frequent intervals (see also Appendix B, page 479).

APPENDICES.

Appendix A.

ABBREVIATIONS USED FOR NAMES OF DYE MANUFACTURERS.

(B.) or (B.A.S.F.) ...	... Badische Anilin und Soda Fabrik, Ludwigshafen a Rhine, Germany.
(Ber.)	... Actien-Gesellschaft für Anilin-Fabrikation, (The Berlin Aniline Co., Ltd.), Berlin S.O. 36, Germany.
(B.K.)	... Leipziger Anilinfabrik Beyer and Kegel, Lindenau-Leipzig, Germany.
(By.)	... The Farbenfabriken vorm Friedr. Bayer & Co., Elberfeld, Germany.
(C.)	... Leopold Cassella & Co., Frankfort-on-the-Main, Germany.
(C.A.)...	... Manufacture Française de Couleurs d'Aniline, Vieux-Condé (Nord), France.
(Ce.) or (C. & R.) ...	... Claus & Co., Ltd., Clayton, Manchester.
(Cl. & Co.)	... The Clayton Aniline Co., Ltd., Clayton, Manchester.
(D.) or (Dahl) ..	... Wulfing, Dahl & Co., A.-G. Aniline Colour Works, Barmen, Germany.
(D. & H.)	... Durand, Huguenin & Co., Basle.
(G.)	... Aniline Colour & Extract Works (late J. R. Geigy), Basle, Switzerland.
(J.)	... Carl Jager, Anilin-Farber Fabrik, Dusseldorf-Dorendorf, Germany.
(K.)	... Kalle & Co., Anilinfarben-Fabrik, Biebrich a Rhein, Germany.
(L.) or (Lev.) ...	... Levinstein Ltd., 21, Minshull Street, Manchester.
(Leon.)	... Farbwerk Mühlheim vorm A. Leonhardt & Co., Aniline Dye & Chemical Works, Mühlheim-on-Main, Germany.
(Lei.)	... J. W. Leitch, Milnsbridge Chemical Works, Huddersfield.
(Ly.)	... Manufacture Lyonnaise des Matières Colorantes, Lyon, France.
(M.L.& B.)	... Farbwerke vorm Meister Lucius & Brüning, Ltd., Hoechst on Main, Germany.
(N.I.)	... Noetzel Istel & Co., Griesheim a Maine, Germany.
(O.) or (Oeh.) ...	... Chemische Fabrik Griesheim Elektron, Werk Oehler, Frankfurt a Main, Germany.
(R.)	... Société Chimique des Usines du Rhone, Lyon, France.
(R.H.& S.)	... Read, Holliday & Sons, Huddersfield.
(S.A.) or (S.A.D.M.C.)	... Société Anonyme des Matières Colorantes (late Pourier), St. Denis, Paris.
(Sch.)	... Schöllkopf, Hartford & Hanna, Buffalo, U.S.A.
(S.C.I.) or (S.C. Ind.)	... Society of Chemical Industry in Basle, Switzerland.
(Uer.) or (W. t. M.) ...	... Chemische Fabriken vorm Weiler-ter Meer, Uerdingen-on-Rhine, Germany.
(W.) or (W. Bros.)...	... Williams Bros., Hounslow, Middlesex.

ABBREVIATIONS USED FOR NAMES OF DYE MANUFACTURERS WITH ADDRESS OF FIRMS AND AGENTS.

(B.) or (B.A.S.F.).

Badische Anilin Und Soda Fabrik. Ludwigshafen a Rhine, Germany.

AGENTS:—

United Kingdom.

BRADFORD, YORKS.—The Badische Co., Ltd., 24, Nelson Street.

GLASGOW.—James Strang & Sons, 121, West George Street.

LONDON.—The Badische Co., Ltd., 20-26, Brunswick Place, City Road, N.

MANCHESTER.—The Badische Co., Ltd., 2, Samuel Ogden Street, Whitworth Street.

East Indies.

BOMBAY.—M. Ostermayer & Co., Post Bon 149.

United States of America.

NEW YORK.—The Badische Co., 128, Duane Street.

(Ber.)

Actien-Gesellschaft Fur Anilin-Fabrikation. (The Berlin Anilin Co., Ltd.), Berlin S.O. 36, Germany.

AGENTS:—

United Kingdom.

BELFAST.—The Berlin Aniline Co., Ltd., 29, Franklin Street.

BRADFORD.—The Berlin Aniline Co., Ltd., 9, Charles Street.

GLASGOW.—The Berlin Aniline Co., Ltd., 79, West Nile Street.

LEICESTER.—The Berlin Aniline Co., Ltd., 46, Melbourne Road.

LONDON —The Berlin Aniline Co., Ltd., 20, Eastcheap, E.C.

MANCHESTER.—The Berlin Aniline Co., Ltd., 26, Princess Street.

Canada

MONTREAL.—McArthur, Corneille & Co.

East Indies

BOMBAY.—Berlin Aniline Co., Bombay Agency.

United States of America.

NEW YORK.—Berlin Aniline Works, 213-215, Water Street.

BOSTON.—Berlin Aniline Works, 124, Pearl Street.

CHARLOTTE, N.C.—Berlin Aniline Works, Trust Building.

CHICAGO, Ill.—Berlin Aniline Works, 229e, Kinzie Street.

PHILADELPHIA.—Berlin Aniline Works, 122, Walnut Street.

(B.K.)

Leipziger Anilinfabrik Beyer and Kegel, Lindenau-Leipzig, Germany.

(By.)

The Farbenfabriken vorm Friedr. Bayer & Co., Elberfeld, Germany.

AGENTS:—

United Kingdom.

BELFAST.—The Bayer Co., Ltd., 14, Linenhall Street.

BRADFORD.—The Bayer Co., Ltd., 157, Leeds Road.

GLASGOW.—The Bayer Co, Ltd., 42, Bothwell Street.

LONDON.—The Bayer Co., Ltd., 19, St. Dunstan's Hill, E.C.

MANCHESTER.—The Bayer Co., Ltd., 18-20, Booth Street, Mosley Street.

Australia.

MELBOURNE.—J. Dyer, 325, Flinders Lane

Canada.

TORONTO, ONT.—Farbenfabriken of Elberfeld Co., 14, Front Street East.

India.

BOMBAY.—The Farbenfabriken Bayer & Co., Ltd., Hornby Row, Fort.

United States of America.

BOSTON.—Farbenfabriken of Elberfeld Co., 32, India Street.

CHARLOTTE, N.C.—Farbenfabriken of Elberfeld Co., Room 509/13, Trust Buildings.

CHICAGO.—Farbenfabriken of Elberfeld Co., 133, Kinzie Street.

NEW YORK.—Farbenfabriken of Elberfeld Co., 117, Hudson Street.

PHILADELPHIA.—Farbenfabriken of Elberfeld Co., 9-11, North Water Street.

PROVIDENCE, R.I.—Farbenfabriken of Elberfeld Co., 27, Pine Street.

(C.) or (Cas.)

Leopold Cassella & Co., Frankfort on the Main, Germany

AGENTS:—

United Kingdom.

BELFAST.—Brown & Forth, 33, Linenhall Street.

BIRMINGHAM.—Pronk, Davis & Co., 24, Pershore Street.

BRADFORD.—F. A. Brassard, 46, Vicar Lane.

GLASGOW.—D. Crawford & Co., 59, Bath Street.

LONDON.—Pronk, Davis & Co., 22, Harp Lane, Great Tower Street, E.C.

MANCHESTER.—Brown & Forth, 10, Dolefield, Bridge Street.

NOTTINGHAM.—Charles Forth & Son, 68, North Gate, New Basford.

(C.) or (Cas.) *continued.*

Australasia.

ADELAIDE.—J. L. Lennard, Torrens Chambers, Victoria Sq.

BRISBANE.—J. L. Lennard, Comm. Union Chambers.

MELBOURNE.—J. L. Lennard, 364, Little Collins Street.

SYDNEY.—J. L. Lennard, 226, Clarence Street.

WELLINGTON, NEW ZEALAND.—J. L. Lennard, Cuba Street, Extension.

East Indies.

BOMBAY.—Leopold Cassella & Co., Bombay Agency, Apollo Street, Sirdar's Palace.

United States of America.

NEW YORK.—Cassella Colour Co., 182-184, Front Street.

(C.A.)

Manufacture Français de Couleurs d'Aniline, Vieux—Condé (Nord), France.

(Ce.) or (C. & R.)

Claus & Co., Ltd., Clayton, Manchester.

(C. & Co.)

The Clayton Aniline Co., Ltd., Clayton, Manchester.

(D.) or (Dahl.)

Wülfing, Dahl & Co., A.-G., Aniline Colour Works, Barmen, Germany.

AGENTS:—

United Kingdom.

GLASGOW.—Bryce & Rumpf, 223, West George Street.

LONDON —C. G. H. Chapman, 9, London Street, Fenchurch Street, E.C.

MANCHESTER.—Thompson & Aitken, Hopwood Avenue, Market Place.

United States of America.

MEXICO CITY.—Watson, Phillips & Cie., 10, Calle Don Juon Manuel.

NEW YORK.—C. Bischoff & Co., 451-453, Washington Street.

Japan.

KOBE.—Tait & Co., Sannomiya-cho, 1, Chome, No. 28.

YOKOHAMA.—Tait & Co., 75, G. Yamoshita-oho.

(D. & H.)

Durand, Hugenin & Co., Basle, Switzerland.

AGENTS:—

United Kingdom.

GLASGOW.—John Wishart, 3, Cadogan Street.

MANCHESTER.—C. Schroeder, 8, Chatham Street, Piccadilly.

(G.)

Aniline Colour and Extract Works, Basle, Switzerland.

AGENTS:—

United Kingdom.

BRADFORD.—C. Roberts & Co., 16, Thornton Road.
GLASGOW —H. Every & Co., 183, Rutherglen Road.
LEICESTER.—E. H. Butler & Son, New Haymarket.
LONDON.—A. & M. Zimmermann, 3, Lloyd's Avenue, E C.
MANCHESTER.—O. Isler & Co., 35-37, Dickinson Street.

(J.)

Carl Jäger, Anilin-Farben-Fabrik, Düsseldorf-Derendorf, Germany.

(K.)

Kalle & Co., A.-G., Anilinfarben Fabrik, Biebrich a Rhine, Germany.

AGENTS:—

United Kingdom.

GLASGOW.—Donald Mills & Son, 55, George Square.
LEICESTER.—A. W. Brook, Wigston Road, C. P.
LONDON.—E. N. Frankenstein & Co., Ropemaker Street, Finsbury, E.C.
MANCHESTER.—Kalle & Co., Ltd., 8, New Cannon Street.

(L.) or (Lev.)

Levinstein, Ltd., 21, Minshull Street, Manchester.

United States of America.

BOSTON.—Levinstein, Ltd., 74, India Street.
PHILADELPHIA.—Levinstein, Ltd., Pa.

Italy.

MILAN.—Levinstein, Ltd., Via a Rosmini, No. 9.

(Leon.)

Farbwerk Mühlheim vorm A. Leonhardt & Co., Aniline Dye and Chemical Works, Mühlheim-on-Main, Germany.

AGENTS:—

United Kingdom.

BELFAST.—James A. Beck & Son.
BRADFORD.—Farbwerk Muhlheim.
GLASGOW.—Andrew Wallace.
KIDDERMINSTER.—Wm. Chadwick.
LEICESTER.—F. W. Green.
LONDON.—G. Dittmann, 6, South Street, Finsbury, E.C.
MANCHESTER.—Farbwerk Muhlheim.

(Leon.) *continued.*

Continental.

CHRISTIANIA.—J. & C. Vendelboe.
COPENHAGEN.—H. Borgen-Nielsen.
GOTEBORG.—H. Bergendahl.
NORRKOPING.—A. Hoek.
ZAANDIJ.—A. Latenstein, Pz.

United States of America.

NEW YORK.—C. Bischoff & Co.

(Lei.)

J. W. Leitch, Milnsbridge Chemical Works, Huddersfield.

(Ly.)

Manufacture Lyonnaise des Matières Colorantes, Lyon, France.

(M. L. & B.)

Farbwerke vorm Meister Lucius & Brüning, Ltd., Hoechst on Main, Germany.

AGENTS:—

United Kingdom.

BRADFORD.—Meister Lucius & Brüning, Ltd., 26, East Parade.
GLASGOW.—Meister Lucius & Brüning, Ltd., 50 Wellington Street.
LONDON.—Meister Lucius & Brüning, Ltd., 51, St. Mary Axe, E.C.
MANCHESTER.—Meister Lucius & Brüning, Ltd., 20, Princess Street.

Canada

H. A. METZ & Co.—Montreal.
Toronto.

East Indies.

BOMBAY.—Meister Lucius & Brüning, Ltd., 32, Hornby Row.

China.

HONG KONG.—China Export, Import and Bank Co.
SHANGHAI.—China Export, Import and Bank Co.

Japan.

KOBE.—China Export, Import and Bank Co.
YOKOHAMA.—China Export, Import and Bank Co.

United States of America.

H. A. METZ & Co.—122, Hudson Street, New York.
Boston, Mass.
Philadelphia, Pa.
Providence, R.I.
Chicago, Ill.
Charlotte, N.C.
Atlanta, Ga.
San Francisco, Cal.
Newark, N.J.

(N.I.)

Noetzel, Istel & Co., Griesheim a Maine, Germany.

(O.) or (Oeh.)

Chemische Fabrik Griesheim Elektron, Frankfort a Main, Germany.

AGENTS:—

United Kingdom.

BRADFORD.—Geo. Kenyon, Ltd., 6, Swaine Street.
LONDON.—Raab & Sons, 25, Milton Street, E.C.
MANCHESTER.—Geo. Kenyon, Ltd., 1, Back Piccadilly.

Continental.

BARCELONA.—R. Masso & Cie., Plazza de Tetuan 14.
BARMEN.—A. Reyscher, Barmen-R
COPENHAGEN.—Emil Warthoe & Sonner.
MILAN —Caetano Ravazzi & Co., 16 Viale Garibaldi.
PARIS.—E. Herzog, 511s/rue Martel.
STUTTGART.—Julius Krug, Schillerstrasse 27.
TORINO.—J. D. Visetti, 3 Via Principe Tammaso.
TOURNAL. (Belgium).—Jules van der Vorst.
VIENNA —Carl Barolin, Apollogasse 8, Vienna VII. 1.

United States of America.

NEW YORK.—Geisenheimer & Co., 189, Front Street, New York.

(R.)

Société Chimique des Usines du Rhone, Lyons, France.

(R. H. & S.)

Read Holliday & Sons, Huddersfield, Yorks.

AGENTS:—

United Kingdom.

GLASGOW.—142, West Nile Street.
MANCHESTER.—38, Fountain Street.

Australasia.

MELBOURNE.—Rosenhain & Bryce, 375, Flinders Lane.
SYDNEY.—Rosenhain & Bryce, 29, O'Connell Street.
AUCKLAND, N.Z.—Rosenhain & Bryce, 23, Swan Street.
CHRISTCHURCH, N.Z.—Rosenhain & Bryce, 139a, Hereford Street.

Canada.

TORONTO.—62, Front Street East.

(R. H. & S.) *continued.*

Continental.

BARCELONA.—B. Bagaria, Calle Cortes, 698.

BARMEN.—Fr. de Brunn.

CONSTANTINOPLE.—M. M. Barnathan & L. A. Bercovitch, Stamboul Barnathan-Han.

FRANKFORT o/MAIN —Gebruder Seitz.

LILLE.—P. de Parades, 12, Parvis Street, Michel.

LODZ.—Arthur Goldstadt.

MILAN.—M Frigerio, Viale Monforte 19.

MOSCOW.—Handelshaus, "Julius Praetorius."

PARIS.—Noel Monthezin, 11, Cite Trevise.

ST. PETERSBURG.—S. G. Martin & Co , 21, Gogol Street.

Japan

OSAKA.—Mitsui Bussan Kaisha (Mitsui & Co.), 2, Chome Koriabashi.

United States of America.

BOSTON —125, Pearl Street.

CHARLOTTE, N.C —27, South Tyron Street.

NEW YORK.—11, Gold Street.

PHILADELPHIA —107, North Second Street.

(S. A.) or (S.A.D.M.C.)

Société Anonyme des Matières Colorantes, St. Denis, France.

AGENTS:—

United Kingdom.

GLASGOW.—W. Bunten & Co., Gordon Chambers, 90, Mitchell Street.

KIDDERMINSTER.—R. S. Blundell, Commercial Buildings.

LEEDS.—E G Jepson & Co., Albion Walkes Chambers.

MANCHESTER —C. C Johnson, 8, Chatham Street, Piccadilly.

Austria

VIENNA.—Wilhelm Neuber, V1/2 Bruckengasse 1.

Belgium and Holland.

BRUXELLES.—Mr. Jean Dujacquier, 96, Boulevard de la Revision.

Denmark.

COPENHAGEN.—Messrs. Th. Lose & Co , Kronprinsensgade 5.

France.

GRAULHET. (Tarn).—M. M. A. Bessey.

MARSEILLES.—Eug. Couchot, 8, Rue Falque.

ROUEN. (Seine Inferieure).—G. Masure Fils, 15, Rue Dumont d'Urville.

Germany.—

BERLIN.—V. Kullak, Augsburgerstrasse 98, Berlin W.—50.

HAMBURG.—F. Baldamus, Hopfenesack 8.

(Sch.)

Schollkopf, Hartford & Hanna, Buffalo, U.S.A.

(S.C.I.) or (S.C.Ind.)

Society of Chemical Industry in Basle, Switzerland, and St. Fons, near Lyons, France.

AGENTS:—

United Kingdom.

BRADFORD.—Heymann, Gaisman & Co., Palmerston Buildings, Manor Row.
GLASGOW.—Arthur & Hinshaw, 88—90, Cadogan Street.
MANCHESTER.—Heymann, Gaisman & Co., Hooley Hill.
LEICESTER.—F. D. Wilson, 57, Charles Street.

(Uer.) or (W.t.M.)

Chemische Fabriken vorm Weiler-ter Meer, Uerdingen-on-Rhine, Germany, and at Cologne-Ehrenfeld, Krefeld, Riehl, Mungersdorf.

AGENTS:—

United Kingdom.

BRADFORD.—Stock & Goedecke, 261-262, Swan Arcade
GLASGOW.—H. D. Hardie & Co., 176, Ingram Street
KIDDERMINSTER.—W. H. Wilkes.
LONDON.—W. T. Lowe, 26a, Southwark Street, S.E.
MANCHESTER.—Stock & Goedecke, 68, Major Street.

Australasia.

MELBOURNE.—James Hardie & Co.
SYDNEY.—James Hardie & Co.
WELLINGTON, N.Z.—C. Klien.

China.

HANKOW.—Garrels, Borner & Co.
HONG KONG.—Garrels, Borner & Co.
SHANGHAI.—Garrels, Borner & Co.
TIENTSIN.—Eduard Meyer & Co.
TSINGTAU.—Eduard Meyer & Co.

India.

BOMBAY.—Pragjee Soorjee & Co.

Korea.

CHEMULPO.—Carl Wolter & Co.

Manchuria.

ANTUNG.—Carl Wolter & Co.

United States of America.

NEW YORK.—C. F. Muller, 100, William Street.

(W.) or (W. Bros.)

Williams Bros., Hounslow, Middlesex.

ACID COLOURS SUITABLE FOR DYEING VEGETABLE TANNAGES.

REDS.

Acid Bordeaux Y., (W. Bros.)
Acid Magenta S, (Ber.)
Archil Substitute (R. H. & S.)
Azorubine, (W. t. M.)
Benzyl Bordeaux B, (S.C.Ind.)
Bordeaux BL, (W. t. M.)
,, B, (Ber.)
,, G., (By.)
Brilliant Acid Carmine (O.)
Burmese Red (Ce.)
Cardinal Red J (R H. & S.)
Carmosine B, (By.)
Crocein AZ, (C.)
Crocein Red 7B, (D.)
Crocein Scarlet 7B, (S A.)
,, ,, 8B, (By.)
Crystal Scarlet 6R, (C.)
Eosamine B, (Ber.)
Erio Rubine B, (G.)
,, ,, 2R., (G.)
,, ,, G, (G.)
Fast Red A, (B.), (Ber.), (By.), (Leon.), (Ce.), (W. t. M.), (O.)
,, ,, AV, (B.)
,, ,, B, (B.)
,, ,, E, (B.), (W. t. M.)
,, ,, ERD, (O.)
,, ,, Ext., (Ber.)
,, ,, K, (W. Bros.)
,, ,, KG, (W. Bros.)
,, ,, O, (M L.& B.)
,, ,, 21528, (By.)
,, ,, 22419, (By.)
Milling Red FR, (C.)
Naphtamine Scarlet B, (K.)
Naphthylamine Red G, (By.)
Oxblood Colour R, (Ber.)
Orchil Red Bluish, (G.)
,, ,, Reddish, (G.)
Ponceau 6RB, (Ber.)
Paper Red PSNR, E, (S.C.Ind.)
Rocceline, (S.C.Ind.)
X L. Red, (R.H. & S.)

REDDISH SCARLETS.

Biebrich Scarlet B, (K.)
Brilliant Crocein, (W. t. M.)
,, ,, MOO (C.)
,, Scarlet R, (W. t. M.)
,, ,, 4RB, (W. Bros.)
Crocein Scarlet B, (By.)
,, ,, 2BN, (By.)

Reddish Scarlets (*continued*).

Crocein Scarlet 3BN, (K.)
Fast Scarlet B, (B.), (W. Bros.)
Fast Scarlet GX, (B.)
Milling Red G, (C.)
Paper Scarlet, (By.)
Ponceau BO Ext (Ber.)
,, 3RB, 4RB, (Ber.)
,, R Ext., (C.A.)
,, S, (Ber.)
Red B, (S A.)
Scarlet B Ext., (M.L.& B.)
,, EC, (C.)
,, 2R, (W. t. M.)
,, RD, 2RD, 3RD, (R.H. & S.)
,, 2RL, (B.)
,, 3R, (M.L & B.)
,, 3RS, (S.A.)
,, S. (D.)
Verv Red L, (Leon.)

ORANGE SCARLETS.

Crocein Scarlet R, (By.)
Diamine Scarlet B, (C.)
Ponceau G, (Ber.)
,, R, (By.)
Scarlet G, (M.L & B.)
,, GL, (B.)
,, Y, (Uer.)
Silk Scarlet G, (By.)

ORANGES.

Atlas Orange, (Ce.)
,, ,, RS., (Ce.)
Crocein Orange (By.), (K.), (W. t. M.)
Fields Orange, (Ce.)
Golden Orange, (By.), (W. t. M.)
Mandarine G Extra, (Ber.)
Orange, (Uer.)
Orange A, (Leon.)
,, BB, (By.)
,, Ext. conc., (C.A.)
,, G, (R.H. & S.)
,, I, (W. t. M.)
,, P, (C.), (O.)
,, R, (S.C.Ind.)
,, R, (O.)
,, T, (W. t. M.)
,, II, (B.), (By.), (C.), (G.), (M.L.&B.) (C.A.), (S.A.), (S.C.I.), (W. t. M.)
,, IV, (R.H. & S.)

Oranges (*continued.*)

Ponceau 4GB, (Ber.)
,, 2R, (Ber.)
,, BO Extra (Ber.)
,, 3RB Extra L, (Ber.)
Pyrotine Orange, (D)

REDDISH YELLOWS.

Acid Yellow S, (C A)
Azo Flavine, (S.C I)
,, ,, R, (B), (C.)
,, ,, 2R & 3R, (B.), (W. t M)
,, ,, RS, (B.), (C)
Azo Yellow, (K), (Uer)
,, ,, conc, (M L & B.)
,, ,, O, (M L & B)
,, ,, R, (M L & B.)
,, ,, 3X, (Uer)
,, ,, I, (S.C I.)
Chrysophenine G, (Ber.), (Leon)
Cuba Yellow, (C), (Uer), (W Bros.)
,, ,, O, (M L.& B.)
Curcumeine Ext. (Ber.)
,, W, (By)
Indian Yellow G, (By)
,, ,, J, (R H. & S)
,, ,, R, (By), (C)
,, ,, T, (C)
Naphtamine Yellow G, (K)
Solid Yellow B & G, (Leon)
Turmeric Yellow (C.), (G), (Uer)

YELLOWS.

Acid Yellow Y, (R H.& S.)
Azo Yellow I, (S.C.Ind.)
Citronine, (Leon)
,, A, (Leon.)
,, G & R, (O)
,, OOO, (S.C. Ind.)
,, RR, (O)
Curcumeine Extra, (Ber.)
Curcumeine S, (By.), (Leon)
Diphenyl Citronine G, (G)
Fast Acid Yellow, (C.A.)
Fast Cotton Yellow, (D)
Milling Yellow O, (C.)
Naphthol Yellow S, (B), (Ber.), (By.), (C.), (M.L.& B.)
Orange II, (G.)
Ponceau 4GB, (Ber.)
Polyphenyl Yellow 3G, (G)
Quinoline Yellow, (B), (Ber.), (By), (M.L.& B.), (R.H.& S), (S.C Ind.)
Tartrabarine, (W. t. M)
Tartrazine, (B.), (S C.Ind.)
Thio Flavine T, (C)

BROWNS.

Acid Anthracene Brown R, (By.)
Acid Brown, (C.A), (G.), (W. Bros.)
,, ,, B, (S.C. Ind.)
,, ,, D, (C.)
,, ,, G, (M L.& B)
,, ,, R, (C.), (M L & B.), (R.H.& S.)
,, ,, R.N.G. (W. t. M.)
,, ,, Y, (S.C.I.)
,, ,, 70731, (S C I.)
Acid Dark Brown, (Ce.),
Acid Leather Brown, (O)
Alizadine Brown R, (R H & S.)
Canelle 5667 & 4477 (Ce)
Chestnut Brown (O)
Dark Nut Brown, (C.), (Uer.)
Fast Brown, (By), (B)
,, ,, G, (Ber)
,, ,, 3B, (Ber.)
Golden Brown Y, (C.)
Leather Brown G, (R H & S.)
,, ,, Y, (R.H & S.)
New Acid Brown, (C & R)
New Golden Brown A1, (C.)
Resorcine Brown, (Ber), (D), (W), (S C Ind.), (R H. & S.)
Solid Brown O, (M.L & B.)

GREENS.

Acid Green, (Uer)
,, ,, BB Ext., (By)
,, ,, 3B, (By)
,, ,, 2BG., (W.t M.)
,, ,, Ext, (By)
,, ,, Ext conc, (C.), (D.), (Ce)
,, ,, G Ext. (M.L & B)
,, ,, G & B, (S.C Ind.)
,, ,, GG, (R.H.& S.)
,, ,, GG Ext, (By.)
,, ,, GO, (O.)
,, ,, J, (S.A)
,, ,, O, (M.L & B.)
,, ,, OG, (O)
,, ,, OOO, (Leon)
Azurine B, (G.)
Benzyl Green B, (S.C Ind.)
Eboli Green B, (Leon.)
Erio Green R Extra, (G.)
,, Glaucine Extra, (pat) (G)
,, ,, R.B. (pat.) (G.)
,, Viridine B, (G.)
Fast Acid Green BN, (C)
Fast Green, (C.A)
,, ,, CR, (By.)
Guinea Green B & G, (Ber)
Light Green SF blue shade, (B.)
,, ,, ,, yellow shade, (B.)
Night Green A, (W.t.M.)

BORDEAUX.

Bordeaux B, (R.H & S.)
,, B Ext. (Ber)
,, BL, (C)
,, COV, (B), (Ber.)
,, Ext (By.)
Chromotrope S, (M.L.& B)
Claret Red B & R, (M.L & B.)
Columbia Violet R, (Ber)
Fast Red B, (B.)
New Claret CM & L, (B)
New Magenta O, (M L & B.)
Orchil Substitute, (W. Bros)

BLUES.

Acid Blue IV, (R.H & S)
Acid Violet 6B, (W t M.)
,, ,, 5BF, (M L & B)
,, ,, 6BN, (Lev)
Bavarian Blue DB, (Ber)
Bright Wool Blue (R H & S.)
Blue DG, (Lev)
,, OT, (R H & S.)
,, R, RR, (Lev)
China Blue, (Ce)
Cotton Blue CL, (S A)
,, ,, I, II & III, (By)
Disulphine Blues (R H & S.)
Erioglaucine B, BB, JB, NW, (G)
Fast Blue for leather, (Ber)
Fast Acid Blue B, (By.), (O)
Induline (S.C.Ind), (G)
,, 5B, R & D, (W. t M)
Leather Blue, (C A)
,, ,, B, 2B, 4B, (G)
,, ,, 2B, (G), (W. t M)
,, ,, 4B, (G)
,, ,, V, (G.)
Light Blue, (W. t. M)
Marine Blue, (Lev)
,, ,, O, (K)
Naphtol Blue (W. t. M)
Navy Blue (W t. M.)
Patent Blue A, (Ber.)
Pure Blue F, (N)
,, ,, AI, ARI, BSI, Blue CIII, (S C.Ind.)
Serge Blue (Ce)
Solid Blue B, (G)
,, ,, D, (C)
,, ,, N, RR, (B)
Soluble Blue (O)
,, ,, BB, R, 3R & 6R, (W. t. M.)
,, ,, M, 2M. 3M, (R.H. & S.)
,, ,, RR, (B)
,, ,, 3 R, (Ce)
,, ,, 3, (R H.& S.)
Water Blue 4B, (Leon.)

Blues (*continued.*)

Water Blue 6B, (Ber.)
,, ,, IN, PP, TR, (B.)
,, ,, R, (Leon.)

BLUISH VIOLETS.

Acid Violet (O.)
,, ,, 2B, (S A.)
,, ,, 3B, 4B, 6B, (By.)
,, ,, 3B, 6B, 10B, (R.H. & S.)
,, ,, 5B, 7B, (G)
,, ,, 6B, (W. t. M.)
,, ,, 3BN, (B.), (Lev.)
,, ,, F, (R H. & S.)
,, ,, 5R, (S A.)
Coomassie Violet S 4B, (Lev.)
Formyl Violet S 4B, (C)
Guinea Violet, 2B, 4B, (B)
,, ,, S 4B, (Ber.)
Violamine B, (M L.& B.)

REDDISH VIOLETS.

Acid Magenta FC, (O)
,, ,, N.S, (O)
,, ,, 2, (R H.& S)
Acid Violet 3BA, (M L & B)
,, ,, 4R, (B), (C)
,, ,, R, (W. t. M)
,, ,, 5B, (G)
Azo Acid Magenta B, (M L & B.)
Clematine, (G)
Chromotrope 10B, (M L & B)
Violamine R, (M.L & B.)

BLACKS AND GREYS.

Amido Naphtol Black 4B conc (M.L.&B.)
Carbon Black B, (M.L. & B)
Deep Black B, (W. t. M.)
Grey B, BR & R, (S C.Ind.)
Grey Bluish (G.)
,, Yellowish (G.)
Naphthalene Black D, 2D, 12B, (R.H.&S.)
Naphthol Black 2B, (By.), (W. t. M.)
Naphthol Blue Black N, (C.)
Naphthylamine Black 4B, (By.), (C.), (W. t. M)
Naphthylamine Black D, (By.), (C.), (W. t. M.)
Nigrosine 3G, soluble in water, (Ber.)
,, B, BR, TBN, TTN, (W. t. M.)
,, S, (S.C.Ind.)
Palatine Black L, (B.)
Phenylamine Black, (By.)
Silver Grey P, (Ber.)
,, ,, N, (C.)
Victoria Black B, (By.)
Wool Black (W. t. M.)
,, ,, 6B, (Ber.)
,, ,, GR, (Ber.)

ACID MIXTURES SUITABLE FOR DYEING AND STAINING VEGETABLE TANNED LEATHERS.

Orange II, (M.L.& B.)
Azo Yellow O, (M.L.& B.)
Patent Blue V, (M.L.& B.)

Resorcine Brown, (Ber.)
Circumein Ext., (Ber.)
Nigrosine 105, (Ber.)

Acid Brown R, (C.)
Indian Yellow G, (C.)
Pure Soluble Blue, (C.)

Azo Flavine RS, (B.)
Fast Red AV, (B.)
Fast Blue R, (B.)

New Acid Brown, (C.& R.)
Phosphine Substitute, (C.& R.)
Induline, (C.& R.)

Acid Brown R, (C.)
Azo Flavine RS, (C.)
Naphthol Blue Black, (C.)

Resorcine Brown, (Ber.)
Fast Brown G, (Ber.)
Naphthylamine Black D, (C.)

Fast Brown G, (Ber.)
Circumeine Ext., (Ber.)
Nigrosine 105, (Ber.)

Fast Brown, (By.)
Indian Yellow R, (By.)
Fast Green Blue Shade, (By.)

Acid Anthracene Brown, (By.)
Indian Yellow R, (By.)
Fast Green Blue Shade, (By.)

Fast Brown N, (B.)
Azo Flavine RS, (B.)
Light Green SF, (B.)

Dark Nut Brown, (Uer.)
Azo Yellow, (Uer.)
Acid Green, (Uer.)

Acid Brown, (D.)
Crocein Orange, (D.)
Cotton Blue 3R, (D.)

Resorcine Brown, (D.)
Cotton Blue 3R, (D.)

Acid Brown B, (S.C.I.)
Cuba Yellow 2072, (S.C.I.)
Acid Green, (S.C.I.)

Resorcine Brown, (W. Bros.)
Cuba Yellow, (W. Bros.)
Acid Green, (W. Bros.)

Naphthol Brown, (Leon.)
Citronine A, (Leon.)
Acid Green OOO, (Leon.)

Naphthylamine Brown, (B.)
Azo Flavine RS, (B.)
Light Green SF, (B.)

Acid Brown R, (R.H.& S.)
Acid Yellow, (R.H.& S.)
Nigrosine Cryst., (R.H.& S.)

Orange II, (S.A.)
Yellow OS, (S.A.)
Acid Green J3E, (S.A.)

Acid Brown, (C.A.)
Acid Yellow S, (C.A.)
Pure Blue Cryst., (C.A.)

Resorcine Brown, (Ber.)
Azo Acid Yellow or Curcumeine Ext. (Ber.)

Indian Yellow R, (C.)
Acid Brown R, (C.)
Pure Soluble Blue, (C.)

Azo Acid Yellow conc., (M.L.& B.)
Solid Brown O, (M.L.& B.)
Fast Blue O Sol., (M.L.& B.)

Bronze Acid Brown, (By.)
Indian Yellow R, (By.)
Fast Green Blue Shade, (By.)

Orange II, (B.)
Scarlet GL, (B.)
Light Green SF ys, (B.)

Orange II, (B.)
Fast Red AV, (B.)
Light Green SF, (B.)

Azo Flavine RS, (B.)
Acid Brown L, (B.)
Light Green SF ys, (B.)

Chocolate, (Uer.)
Tartrazine, (B.) or Azo Yellow, (Uer.)

BASIC COLOURS SUITABLE FOR DYEING VEGETABLE TANNAGES.

REDS.

Brilliant Safranine G, (Ber.)
Camelia B, (Ber.)
Cerise 6485, (S. C Ind.)
Fine Rosein, (Ce)
Magenta Crystals, (S. C. Ind.)
Rhodamine B, (Ber.)
,, G. & B. (S. C Ind.)
Rubine Small Crystals, (Ber.)
Russia Red, (S C I), (O)
,, ,, A, (G)
,, ,, B, (B), (C), (M.L.& B.)
,, ,, G, (B), (Ber), (C)
,, ,, G, (G.)
,, ,, R, (By)
,, ,, Yellow & Blue Shade, (S C Ind.)
,, Leather Red, GR, (Ber)
,, ,, ,, LM, (Ber.)
Safranine, (D.), (Lev)
,, AG Ext , (K)
,, Ext (R H & S)
,, Ext B, (G), (C.A)
,, Ext J, (C A.)
,, G Ext , (B), (Ber.), (Leon)
,, G & B, (W. t. M.)
,, GO Ext , (C)
,, GOOO, (S C. Ind)
,, JC, (S A)
,, JE, (S A.)
,, O, (M.L & B.)
,, Prima, (R H.& S)
,, RS, (C)
,, SF, (O)
,, Superfine Double B, (G.)
,, T, (B), (G)
,, 2, (S.C I)

BROWNISH ORANGES.

Chrysoidine, (C. & R.), (S.A.), (O.)
,, AG, (C.)
,, C Ext., (M.L.& B.)
,, Cryst , (C)
,, DC, (C A)
,, Diamond Cryst. Y, (W. Bros.)
,, Ext., (Ber.)
,, C, (By), (Lei.)
,, J, (S C I.)
,, Large Crystals, (Ce.)
,, ,, ,, (W. t. M.)
,, Small Crystals, (W. t. M.)

Brownish Oranges (*continued.*)

Chrysoidine, in powder, (W. t. M.)
,, O, (Leon)
,, R, (Lei.), (R.H.& S.)
,, RCE, (Lev.)
,, RE, (Lev.)
,, Y, (Lei), (R.H.& S.)
,, YY, (C.)
,, YYB, (W. Bros)

REDDISH YELLOWS.

Corioflavine G. & R, (O.)
Diamond Phosphine R, (C)
Euchrysine GG, R, RR, (Ber.)
Flavophosphine GO, new, (M. L. & B.)
,, RO, ,, (M. L. & B.)
Homophosphine G, (Leon)
Lavalliere, (C.A)
,, I, II, (By.)
Leather Yellow, (W. t. M.)
,, ,, (O.)
Leather Phosphine Ext., (G.)
,, Orange G, (G.)
New Phosphine (C), (Uer.)
,, ,, G, (C)
Oxy Phosphine G, (C.A.)
Paraphosphine 2A, (C.)
Patent Phosphine G, (S.C.I)
Phosphine, (O.)
,, 1A, (C.)
,, E, (B.)
,, Ext., (S.A.)
,, G, (Ber.)
,, GO, (K.)
,, L, (B.)
,, O, (M.L & B.)
,, II, (C)
Pure Phosphine, (C.), (Ce.)
Vitoline Yellow, 5G., (W. t. M.)
Walsall Phosphine, (Ce.)

YELLOWS.

Auramine G, (Leon.)
,, O, (B.), (Lev.), (Ce.), (M.L & B),(S.C Ind.), (Ber.)
,, II, (B.), (Ber.), (By.), (C.), (C.A.),(Ce.),(M.L.&B.), (G.), (K.), (Leon.), (R. H. & S.), (S.C.I.), (Uer.) (W. Bros.), etc.
Aurophosphine 4G, 4GK, (Ber.)

Yellows (*continued.*)

Brilliant Phosphine, G extra, (Ber.)
,, ,, 5G, 3G, G, (S.C. Ind.)
Corioflavine GG, (O.)
Chrysoidine Y. R, (S. C. Ind.)
Flavophosphine, 4G, New, (M.L.&B.)
Leather, Yellow AL, (S.C. Ind.)
,, ,, 3G, (M. L. & B.)
,, ,, Geigy conc., (G)
Patent Phosphine G, GG, M, R, (S. C. Ind.)
Phosphine extra, (Ber.)
,, 3R, (Ber.)
Philadelphia Yellow G, (Ber.)

BROWNISH YELLOWS.

Aurophosphine G, (K.), G, GK, (Ber.)
Canella D, (C.)
,, for leather, (By.)
,, (G.), (S.C.I.), (W. Bros.)
Canelle R, (S.C.I.)
,, I, II, (S.C.I.)
Coriphosphine O, (By.)
Diamond Phosphine D, (C.)
Exanthine GGO, GGGO, (O.)
Leather Brown G, (M. L. & B.)
,, ,, O, (M. L. & B.)
Leather Yellow G, (M. L. & B.)
,, ,, R, (W. t. M.)
Nankin Ext., (B.)
,, 5732, (S.C.I.)
New Phosphine G, (C.)
Patent Phosphine GG, (S.C.I.)
,, ,, M, (S.C.I.)
Phosphine 2A, (C.)
,, Ext., (C.A.)
,, GC, (Leon.)
,, 1J, (S.A.)
,, 2J & 3J, (S.C.I.)
,, N, (Ber.)
,, 3R & 3RB, (Ber.)
,, R Ext., (O.)
,, S, (R.H. & S.)
,, 1 (S.A.)
Rheonine A, AL & G, (B.)
Xanthine G, (O.)
,, II, (S.A.)

BROWNS.

Bismark Brown extra, (Ber.)
,, ,, F conc., (By.)
,, ,, FS, (C.)
,, ,, G Ext., (S.C.I.)
,, ,, GG, (C.)
,, ,, GO, (O.)
,, ,, NYY, (W. Bros.)
,, ,, O Ext., (Leon.)
,, ,, 2R, (W. t. M.)
,, ,, RCE, (Lev.)

Browns (*continued.*)

Bismark Brown R conc., (K.)
,, ,, R Ext., (Ber.)
,, ,, RN, (C.)
,, ,, ROO, (O.)
,, ,, R. S, (Ce.)
,, ,, R, (R. H. & S.)
,, ,, Y extra, (Ber.)
,, ,, Y & R, (S. C. Ind.)
,, ,, Y S, (Ce.)
Brown G, (G.)
,, R, (G.)
Cannelle 1352, 63N, OF, 8337, (S.C. Ind.)
,, I & 5733, (S. C. Ind.)
Havanna Brown, (Ber.)
Phenylene Brown 2G, (W. t. M.)
Philadelphia Brown 14476, (Ce.)
,, ,, (Ber.)
Phœnix Brown D extra, (Ber.)
Vesuvine, (C.)
,, B, (B.)
,, BB, (Ber.)
,, conc., (M. L. & B.)
,, OOO, (B.)

GREENS.

Benzale Green, (O.)
Brilliant Green, (Leon.), (Lev.), (S.A.), (S.C.I.), (O.)
Brilliant Green Cryst., (W. t. M.)
Capri Green B & G, (Leon.)
China Green Cryst. A, (By.)
Dark Russian Green 45021, (Ber.)
Diamond Green B, (B.), (By.)
,, ,, G, (B.)
Dragon Green, (Ce.)
Emerald Green (By.)
,, ,, Cryst., (By.), (D.)
Ethyl Green Cryst., (Ber.)
Imperial Green 3G, (By.)
Malachite Green, (C.A.), (G.), (K.), (Lev.), (M.L. & B.), (Ber.), (Ce.)
Malachite Green Cryst., (C.A.), (W.t.M.), (Ber.), (M. L. & B.)
,, ,, Cryst. A, (R.H. & S.)
Methylene Green (W. t. M.)
Methyl Green, (By.), (D.), (W. t. M.)
,, ,, G, (D.)
,, ,, YS, (By.)
Solid Green Cryst., (C.), (Leon.)
,, ,, P, (Leon.)

BLUES.

Bengal Blue B, (G.)
,, ,, R, (G.)
China Blue, (M.L.& B.)
Fast Blue R. Cryst., (Ber.)
Fast Navy Blue, (O.)
Methylene Blue, (Lev.), (O.)

Blues (*continued.*)

Methylene Blue BB., (G.)
,, ,, BG, M, 2B.
,, ,, B, (R H.& S)
,, ,, 2B, (B.), (By.), (C & R), (M.L & B.)
,, ,, 2B conc., (M.L.& B)
,, ,, 2B powder extra, (Ber.)
,, ,, G,(S C. Ind.),(W.t.M.)
Methyl Water Blue, (B)
Naphtol Blue B. & R., (W. t. M.)
New Blue R. S., (S C. Ind.)
New Methylene Blue BB, (C.)
,, ,, ,, GG, (C)
,, ,, ,, S, (Ce.)
Setocyanine, (G)
Setopaline, (G)

BLUISH VIOLETS.

Clematine, (G)
Crystal Violet, (W. t. M)
,, ,, 5BO, 5BI, (S. C. Ind)
Methyl Violet B, (By), (K)
,, ,, B Ext , (Ber)
,, ,, BB, (O)
,, ,, BO, (Leon.)
,, ,, BX, (C)
,, ,, 2B, (D), (M.L & B), (Uer)
,, ,, 3B, (Ber), (N.I)
,, ,, 4B, (Ber), (Uer)
,, ,, 5B, (K)
,, ,, 6B, (Ber), (C), (C.A), (G), (Leon), (Lev), (N I), (O.), (Uer)
,, ,, 7B, (C)
,, ,, 10B, (W. t. M.)
,, ,, 4O, (R H & S)
Paris Violet C, (S A)
,, ,, N, (S A)
,, ,, XE, (S.A.)
Violet Cryst O, (M L & B.)
Violet B, (S. C. Ind.)

REDDISH VIOLETS.

Methyl Violet B, (O).
,, ,, R, (Ber.), (W. t. M.)
,, ,, 2R, (W. t. M.)
,, ,, 3R, (Ber), (W. t M.),(O.)
,, ,, 3R, 2B, 5B, 8B,(R.H.&S.)
,, ,, 4R, (B.), (C.), (W. t. M.)
,, ,, 4R conc., (C A)
,, ,, 5R, (W. t. M.)
Neutral Violet, (C.)
,, ,, XN, (C)
Soda Voilet, (S. C. Ind.)

BORDEAUX.

Cerise A, (Leon)
,, G. & B., (W. t. M)
,, L, (C)
,, P4, (B)
,, 1, (R.H & S)
Fuchsine N, (Lev)
,, JE, (S A)
,, JJ, (S A)
Grenadine B, (O)
Magenta, (C A), (K)
,, 3B, (Ber)
,, Cryst , (Leon.), (O), (S.C.I), (M. L. & B.), (Uer.)
,, Diamond Cryst , (B)
,, L. & H., (R H.& S)
,, NB, (Leon.)
,, NG, (Leon)
,, C, (M L.& B)
,, RF, (Leon)
,, Scarlet G, (B)
Rubine, (Ber)
Safranine Bluish Extra, (K.)

BLUISH REDS.

Rhodamine, (B)
,, B, (B.)
,, B Ext , (B.)
,, BM, (Ber.)
,, G, (By.)
,, Red, (By.)
,, Red B, (By.)
Rosazeine, (M.L.& B.)

BASIC MIXTURES SUITABLE FOR DYEING AND STAINING VEGETABLE TANNED LEATHERS.

Bismark Brown M, (By.)
Auramine II, (By.)
Methylene Blue BB, (By.)

Rheonine A, (B.)
Vesuvine B2, (B.)
Diamond Green G, (B.)

Bismark Brown O, (Leon.)
Auramine II, (Leon.)
Solid Green P, (Leon.)

Bismark Brown Ext., (Ber.)
Philadelphia Yellow R, (Ber.)
Malachite Green Cryst., (Ber.)

New Phosphine G, (C.)
Chrysoidine, (C.)
New Blue B, (C.)

Phosphine Ext., (C.A.)
Chrysoidine Diamond Cryst., (C.A.)
Bright Green Cryst. Ext., (C.A.)

Bismark Brown GG, (O.)
Aniline Yellow Ext., (O.)
Neutral Violet Ext., (O.)

Dark Brown B, (By.)
Auramine LL, (By.)
Emerald Green Cryst., (By.)

Phosphine 3RB, (Ber.)
Philadelphia Yellow R, (Ber.)
Russian Green 36784, (Ber.)

Bismark Brown RS, (C. & R.)
Cannella, (C. & R.)
Malachite Green, (C. & R.)

Vesuvine conc., (M.L.& B.)
Auramine conc., (M.L.& B.)
Methylene Green, (M.L.& B.)

Cutch Brown, (Lei.)
Lemon Yellow C, (Lei.)
Russian Green 3B, (Lei.)

Bismark Brown 2B, (K.)
Yellow for Leather Ext., (K.)
Malachite Green Cryst., (K.)

Auramine, (G.)
Brown R, (G.)
Malachite Green, (G.)

Auramine O, (Lev.)
Bismark Brown RCE, (Lev.)
Brilliant Green, (Lev.)

Bismark Brown Y 40, (R.H. & S.)
Canary 2, (R.H. & S.)
Green Cryst. Y, (R.H. & S.)

Leather Brown A, (S.C.I.)
Auramine II, (S.C.I.)
Leather Black I, (S.C.I.)

Leather Black R, (Uer.)
Yellow 4803, (Uer.)
Blue Black S, (Uer.)

Bismark Brown NYY, (W. Bros.)
Cannella G, (W. Bros.)

Brown for Leather 375, (D.)
Fast Yellow 168, (D.)
Methyl Green G Ext. fine, (D.)

Brown N, (D.)
Leather Brown P, (D.)
Paris Violet O, (D.)

Bismark Brown RCE, (Lev.)
Auramine O, (Lev.)
Brilliant Green (Lev.).

ACID COLOURS SUITABLE FOR STAINING VEGETABLE TANNED LEATHER.

REDS AND ORANGES.

Aniline Orange, (C. & R.)
Archil Substitute (R. H. & S.)
Atlas Orange, (B.), (C & R.)
,, ,, YS, (B.)
Brilliant Crocein MOO, (C.)
Bordeaux B, (By.), (M.L.& B.)
,, COV, (Ber.)
,, G, (By.)
Cardinal Red J, (R.H & S.)
Crocein Orange, (K.), (W. t. M.)
,, Scarlet 3BN, (By.)
Eosine Ext Blue Shade, (By.)
,, Ext Sol., (M L & B.)
,, JE, (S A.)
Erythrosine Ext. Sol., (Ber.)
Fast Red A, (B.), (Ber.), (By.), (Leon.), (O.)
,, ,, AV, (B.)
,, ,, F, (B.)
,, ,, 21528, (By.)
Methyl Eosine, (Ber.)
Phloxine BT, (B.)
Ponceau 4GB, (Ber.)
Orange IIB, (By.)
,, II, (B.),(C.),(M.L.& B.),(S C.I.)
,, IV, G, (R.H. & S.), (W. t. M.)
,, P. & R., (O.)
Roccelline, (W. t. M.)
Scarlet R, (By.)
,, R.D., 2RD, 3RD, (R.H. & S.)

YELLOWS.

Acid Yellow, F.Y. (R.H. & S.)
,, Phosphine JO, (C.)
Aniline Yellow Ext., (Ber.)
Azo Acid Yellow, (Ber.)
,, Flavine RS, (B.), (C.)
,, ,, 3R, (B.), (W. t. M.)
,, Yellow, (Uer.)
,, ,, conc., (M.L.& B.)
Chrysoine, (W. Bros.)
Citronine G. & R. (O.)
Curcumeine Ext., (Ber.)
Cuba Yellow, (C.), (S.C.I.), (W. Bros.)
,, ,, 2072, (S.C.I.)
Fast Acid Yellow, (C.A.)
Golden Yellow, (Ber.)
Indian Yellow G, (C.)
,, ,, J, (R.H. & S.)

Yellows (*continued.*)

Indian Yellow, R, (By.), (C.)
Lemon Yellow Y, (Lei.)
Naphthol Yellow S, (B.), (By.), (C.)
Phosphine Substitute, (B.), (C. & R.)
Quinoline Yellow, (By.), (R.H. & S.)
Solid Yellow B. & G, (Leon.)
Tartrazine, (B)
Turmeric Yellow, (C.), (G.)
,, ,, Substitute, (W. Bros.)

BROWNS.

Acid Anthracene Brown R, (By.)
Acid Brown, (Ber.), (Uer.), (W. Bros.)
,, ,, B, (S.C.I.)
,, ,, conc., (W. Bros.)
,, ,, D, (C.)
,, ,, L, (B.)
,, ,, R, (C.), (R.H.& S.), (Uer.)
,, ,, Y, (S.C.I.)
Acid Leather Brown, (O.)
Alizarine Brown R, (R.H. & S.)
Anthracene Brown R, (By.)
Bronze Acid Brown, (By.)
Brown A1 & A2, (C. & R.)
Canella 4477, (C. & R.)
Chestnut Brown, (O.)
Dark Brown, (C.)
Dark Nut Brown, (Uer.), (W. Bros.)
Fast Brown, (Ber.), (By.)
,, ,, G, (Ber.)
,, ,, GR, (Ber.)
,, ,, N, (B.)
Leather Brown, G, Y., (R.H.& S.)
Resorcine Brown A, (R.H. & S.)

GREENS.

Acid Green, (R.H. & S.), (Uer.), (O.)
,, ,, B. & BB Ext., (By.)
,, ,, Ext., (By.)
,, ,, Ext. conc., (C.), (D.)
,, ,, G & GG Ext., (By.)
,, ,, OOO, (Leon.)
,, ,, GG, (R.H. & S.)
Erioglaucine, (G.)
Guinea Green B & G, (Ber.)
Light Green SF, (B.)

Acid Colours Suitable for Staining Vegetable Tanned Leather (*continued.*)

BLUES.

Acid Blue IV, (R.H. & S.)
Bavarian Blue DB, (Ber.)
Blue I, II, III, (Lev.)
Bright Wool Blue, (R.H. & S.)
Cotton Blue S, (By.)
Cyanole Ext., (C.)
Disulphine Blues, (R.H. & S.)
Fast Blue, (O.)
Marine Blue O, (R)
Solid Blue, (M.L & B)
Soluble Blue M, 2M, 3M, (R.H. & S.)
,, ,, (O.)
,, ,, IN, PP & XX, (B)
Water Blue 3B, 6B, (Ber)
,, ,, N, (B)

VIOLETS.

Acid Violet, (O)
,, ,, 3B, 6B, 10B, F, (R.H. & S.)
,, ,, 6B, (By.)
,, ,, 7B, (Ber.)
,, ,, 4R, (B.)
,, ,, 4RS, (Ber)
Formyl Violet S & B, (C)
Neutral Violet X, (C.)

BLACKS.

Naphthylamine Black D, (C.)

BASIC COLOURS SUITABLE FOR STAINING VEGETABLE TANNED LEATHER.

REDS.

Russia Red, (W. t. M.)
Russian Red, (Ber), (By.), (O)
Safranine, (B.), (Ber), (By), (C.A), (O.), (K.), (Leon), (M L.& B), (S.C.I), (Uer)
Safranine Prima, (R. H & S)

YELLOWS.

Acridine Yellow NC, (Leon)
Auramine O, (R H. & S.)
,, II, (B.), (Ber.), (By)
,, II patent, (S.C.I)
Canary GG, (R H & S)
Cannella G, (W Bros)
Chrysoidine, (R H & S)
,, Cryst , (By), (C & R) (W. t M)
,, Diamond Cryst ,(W Bros)
,, R. & Y, (Lei.)
Corioflavine, (O)
Coriphosphine O, (By)
Euchrysine GG, R, RR, (B)
Homophosphine G, (Leon)
Leather Yellow DRR, (Ber)
Leather Yellow G, (M L.& B)
,, ,, GG, (O)
,, ,, O, (M L & B)
,, ,, 374, & 375, (D)
,, ,, 6730, (C A.)
New Phosphine G, (C)
Oxy Phosphine G, (C A.)
Paraphosphine R. & G, (C)
Patent Phosphine G.& GG, (S C I)
,, ,, R, (S.C.I.)
Philadelphia Yellow, (Ber.)
,, ,, OR, (Ber.)
Phosphine ABN, (Leon)
,, N, (Ber.)
,, Y, (R.H. & S.)
Pure Phosphine, (C.)
Vitoline Yellow 5G, (W. t. M.)
Xanthine (O.)

BROWNS.

Bismark Brown A, R, Y, (R.H. & S.) (By.), (W. t. M.), (O.)
,, ,, 2B, (K.)
,, ,, C Ext., (Leon.)
,, ,, Ext. (Ber.)
,, ,, F, (By.)
,, ,, GG, (C.)

Browns (*continued.*)

Bismark Brown M, (By.)
,, ,, NYY, (W Bros)
,, ,, RCE, (Lev.)
,, ,, R Ext., (Ber)
,, ,, RS, (C & R)
,, ,, Y3, (R.H. & S.)
,, ,, 12196, (Ber.)
,, ,, 3762, (W Bros)
Brown for Leather O, (M L & B.)
Brown R & G, (G.)
Chrysoidine AG, (O), (C)
,, G, (C), (W. t. M.)
,, R.Y., (R.H. & S.)
Cutch Brown, (Lei.)
Leather Brown, (Lei)
,, ,, GG, (By.)
,, ,, OO, (O.)
,, Dark Brown, (Lei)
Manchester Brown, (C)
Nankin I Ext. & II, (B.)
Phenylene Brown G. & 2G., (W. t. M.)
Rheonine A & N, (B)
Vesuvine B, (B)
,, conc , (B), (M.L.& B.)
,, OOO, (B)

GREENS.

Brilliant Green, (O)
Brilliant Green Crystals Y, (R H. & S)
Benzal Green, (O)
Ethyl Green Cryst., (Ber.)
Malachite Green, (Ber.), (C.), (C A.), (C.& R.), (Lev.), (K.), (M.L.& B.), (R.H.& S.), (S.A.), (S.C.I.), (W. t. M.)
Methylene Green, (M.L.& B.), (W. t. M.)
Methyl Green Cryst., (Ber.), (W. t. M.)
Solid Green, (Leon.)

VIOLETS.

Methyl Violets, (B.), (Ber.), (By.), (C.), (C.& R.), (D.), (M.L.& B.), (R.H.& S.), (S.A.), (S.C.I.), (W. t. M.), (O.), etc.

BLACKS.

Corvoline B.& G, (B.), (C.& R.)
Leather Black, (O.)
,, Blacks A.B.C.D., (R.H. & S.)
Vitoline Black B. & T., (W. t. M.)

ACID DYES SUITABLE FOR DYEING CHROME-TANNED LEATHER ON VEGETABLE (TANNIN) MORDANT.

REDS.

*Acetopurpurine 8B, (Ber.)
Bordeaux B, (R.H. & S.)
*Bordeaux COV, (Ber.)
Bordeaux Ext., (By.)
Cardinal Red J, (R.H. & S.)
Cochineal Scarlet PS, (By.)
*Columbia Fast Scarlet 4B, (Ber.)
Crocein Scarlet 3B, (K.)
*Diamine Red B, (Ber.)
*Diphenyl Purpurine extra (G.)
*Diphenyl Red 8B extra (G.)
Fast Scarlet B, (B.)
New Red B, (C.)
Ponceau 4RB, (Ber.)
Roccelline, (C.)
,, (W. t. M.)
Scarlet RD, 2RD, 3RD, (R.H. & S.)
*Terra Cotta F conc. (G.)

ORANGES.

Aniline Orange (C & R.)
Atlas Orange RS & YC, (C & R.)
*Congo Orange R, (Ber.)
*Chrysophenine G, (Ber.)
Crocein Oranges, (By.), (K.)
*Curcumine S, (Ber.)
*Diphenyl Orange (G.)
Mandarine G Ext. (Ber.)
Orange A, (Leon.)
,, G, (R.H.& S.)
,, GG Cryst. (C.)
,, P, (O.)
,, II, (B.), (By.), (C.), (M.L.& B.), (W. t. M.), (S.C.I.)
Ponceaus, (Ber.), (By.)
Xylidine Orange, (W. t. M.)

YELLOWS AND YELLOWISH BROWNS.

Acid Yellow, (Ber.)
,, ,, FY, (R.H. & S.)
Azo Flavine, (R.), (W. t. M.)
,, ,, (R.), (M L.& B.)
,, ,, 3R, (B.), (W. t. M.)
,, ,, RS, (B.), (C.)
,, ,, 7032, (S.C.I.)
Azo Phosphine O, (M.L.& B.)
Azo Yellow (Uer.)
,, ,, conc., (M.L.& B.)
,, ,, FY, (R.H.& S.)

Yellows and Yellowish Browns (*continued.*)

Azo Yellow R, (M.L.& B.)
Chrysoine Ext., (W. Bros.)
Chrysobarine G, (W t. M.)
*Chrysophenin G., (Leon.)
Citronine, (Leon.)
,, G. & R., (O.)
*Crumpsall Yellow RFP, YYFP, (Lev.)
Cuba Yellow, (C.), (W. Bros.)
,, ,, 2072, (S C I.)
Curcumeine Ext., (B.), (Ber.)
*Diphenyl Yellow G conc., (G.)
* ,, Bronze I, (G.)
Golden Orange R, (Lei.), (W. t. M.)
Indian Yellow G, (By.), (C.)
,, ,, J, (R H. & S.)
,, ,, R, (By.), (C.)
,, ,, T, (C.)
,, ,, Y, (C.)
*Milling Brown G, (Leon.)
Naphthamine Yellow 2G & 3G, (K.)
Naphthol Yellow S, (B.)
Orange GG, (C.)
,, 1, (W. t. M.)
,, 4, (R H & S.), (W. t. M.)
Phosphine Substitute, (B.), (C & R.)
Quinoline Yellow, (B.), (Ber.), (By.), (R.H.& S.)
Resorcine Yellow, (Ber.)
*Solid Yellow B, 2G & Y, (Leon.)
*Sun Yellow G, (G.)
* ,, ,, 3G, (G.)
Turmeric Substitute, (W. Bros.)
Turmeric Yellow, (G.), (Lei.), (W.t M.)
,, ,, B&Y, (Lei.)

BROWNS.

Acid Anthracene Brown R, (By.)
Acid Brown, (C.), (K.), (R.H.& S.), (Uer.), (W. Bros.)
,, ,, B&Y, (S.C.I.)
,, ,, G & R, (W. t. M.)
Acid Leather Brown (O.)
Acid Phosphine JO, (C.)
Archil Brown G, (By.)
Azo Phosphine, (Uer.)
Bronze Acid Brown, (By.)
Chestnut Brown, (O.)
*Chrome Leather Brown R, (Ber.)
* ,, ,, ,, G, (Ber.)
Chocolate, (Uer.)
*Columbia Brown M, (Ber.)

*Direct Colours.

Browns (*continued.*)

*Congo Brown G, (Ber.)
Dark Acid Brown 2357, (B.)
Dark Brown B, (By)
Dark Nut Brown, (R.), (Uer.)
*Diphenyl Brown BN extra, (G)
* ,, ,, G conc., (G.)
* ,, ,, BV extra, (G)
Fast Brown, (By.)
,, ,, G, (Ber.)
,, ,, N, (B.)
Golden Brown, (Lei)
,, ,, V, (C.), (W. Bros)
Havannah Brown S conc , (C.)
Leather Buff, (Ce.)
Light Nut Brown, (Uer.)
Naphthamine Brown 4E, 4G, (K.)
Napthol Brown T, (Leon)
Naphthylamine Brown, (B)
New Acid Brown, (B.), (C & R.)
New Golden Brown, A1, (C)
Nut Brown 7063, (W. Bros.)
Resorcine Brown, (Ber), (D.), (R H.& S.), (W. Bros.)
Tan Brown A, (Ce.)
,, ,, B, (Ce.)
,, ,, G extra, (Ce.)
Zambesi Brown G, (Ber.)

GREENS.

Acid Green, (Uer), (O)
,, ,, Conc , (M L & B.)
,, ,, Ext. conc , (C.), (D.)
,, ,, GG, (R.H. & S)
,, ,, GG Ext., (By.)
,, ,, OOO, (Leon.)
,, ,, 5677, (W. Bros.)
*Columbia Green, (Ber.)
Erioglaucine, (G.)
Fast Acid Green B & BN, (C.)
Guinea Green G & B, (Ber)
Light Green SF, (B)
,, ,, 2G, (W. t. M.)
,, ,, 2GM, (W. t. M)
Naphthol Green B, (C.)

BLUES AND VIOLETS.

Acid Blue IV, (R. H. & S.)
,, ,, (C.A.)
Acid Violet 2B, (Ber.)
,, ,, 3B, 6B, 10B, (R. H. & S.)
,, ,, 3BN & 6BN, (Lev.)
,, ,, 6B, (W. t. M.)
,, ,, F, (R H.& S.)

Blues and Violets (*continued.*)

Alkalie Blue 6B, (By.)
Bavarian Blue DB, (Ber.)
Blue R & RR, (Lev.)
*Bright Wool Blue, (R. H. & S.)
*Congo Fast Blue B, (Ber.)
* ,, ,, ,, R, (Ber.)
*Columbia Violet R, (Ber.)
* ,, Blue G, (Ber.)
Cyanole Extra, (C.)
*Disulphine Blue, (R. H. & S.)
*Diphenyl Blue 2B, (G.)
,, ,, Black extra, (G.)
,, Violet R, (G.)
Fast Blue O, (M.L.& B.)
Guinea Violet 4B, (Ber.)
Naphthol Blue R 144, (D.)
*Polyphenyl Blue G conc., (G.)
Setocyanine, (G)
Soluble Blue 2B, 3R, & 5R, (W. t. M.)
,, ,, IN, PP, (B.)
,, ,, M, 2M, 3M, (R. H. & S)
,, ,, (O)
Water Blue 4B, (Leon.)
,, ,, 6B, (Ber.)
,, ,, TR, (B.)

GREYS.

Aniline Grey, (Ber.)
Nigrosine B. & T., (W. t. M.)
Silver Grey, (Ber.)

BLACKS.

Chrome Leather Black, (C.& R.),(Ber.) (By.), etc.
* ,, ,, ,, F. (Ber.)
* ,, ,, ,, H. (Ber.)
,, ,, ,, R.B,(R.H & S.)
,, ,, Brilliant Black, (W. t. M.)
*Columbia Black E.O., (Ber.)
Coomassie Black 4BS, (Lev.)
*Diphenyl Deep Black G conc., (G.)
* ,, ,, ,, R ,, (G.)
* ,, ,, ,, V ,, (G.)
French Black, (Uer.)
Leather Black V, (By.)
,, ,, 1, (S.C.I.)
Naphthol Black B, (C.)
Napthalene Black D, 2D, 12B.
Naphthylamine Black 4B & 6B, (C).
*Perchromin B, (Ber.)
Phenylamine Black 4B, (By.)
*Polyphenyl Black T conc., (G.) (R. H. & S.)
Sloeline No. 2, (Ce.)

* Direct Colours

BASIC COLOURS SUITABLE FOR DYEING CHROME-TANNED LEATHER ON VEGETABLE (TANNIN) MORDANT.

Auramine II, (B.), (Ber.), (By.), (C.), (C.A.), (C & R.), (G.), (K.), (Leon.) (M.L. & B.), (O.), (R.H.& S.), (S.A), (S.C.I), (W. Bros), &c
Aurophosphine G, 4G, 4GK, (Ber.)
Bismark Brown, (Ber.), (By.), (C.), (W t. M), (R.H.& S.)
Chrysoidine, (Ber.), (By.), (C), (C & R.), (W. t M.), (R.H.&S)
Corioflavine R, G & GG, (O.)
Coriphosphine O, (By.)
French Black, (W. t. M.)
Havannah Brown 2, (Ber)
Homophosphine, (Leon.)
Leather Phosphine Ext., (G.)
Leather Yellow A (G)
,, ,, L, G, R, (O.)
Manchester Brown PS, (C)
New Phosphine G, (C.)
Ox Blood A, (C).
Paraphosphine AGE, (C.)
,, G, (C.)
,, L, (C)
Phenylene Brown 2G, (W. t. M)
Philadelphia Yellow 4G, (Ber)
Phosphine ABN, (Leon).
,, C.A. (Ber)
,, G, (Ber.)
,, N, (Ber.)
,, O, (M.L & B), (R.H & S)
,, R, (R.H & S)
,, R, LB, (O).
,, 3R, (Ber)
,, 3RB, (Ber.)
,, Y, (R H.& S)
Tannin Brown B, (C)
Vesuvine OOO, (B.)
Xantin 3GO, GGO, G, (O.)

ACID AND BASIC COLOURS SUITABLE FOR DYEING AND STAINING ALUM KID.

REDS.

Eosine, (B), (Ber.), (By.), (C), (Leon).
Erythrosine, (B), (Ber), (By), (C.), (Leon)
Phloxine B, (B.)
Rose Bengal, (B), (Ber), (By), (C)
*Safranine, (B), (Ber.), (By.), (C), (C.& R.), (K), (Leon), (O.), (W. t. M.), (R H. & S), (W. Bros.), &c.

BROWNS.

Acid Brown, (C.), (D)
*Bismark Brown, (B), (Ber), (By), (C.), (C.A), (C & R.), (K), (Leon.), (M.L.& B.), (O.), (R H & S.), (S.A.), (S.C I.), (W. Bros), (W. t. M.), &c.
Bronze Acid Brown, (By)
Canella, (B.), (By)
*Chrysoidine, (B.), (Ber.), (By.), (C.), (C.A.), (C.& R.), (K.), (Leon), (M L.& B.), (O.), (R.H.& S.), (S.A.), (S.C.I.), (W. Bros.), (W. t M.), &c.
Dark Nut Brown, (C.), (G.), (Uer.)
Mikado Brown, 3G, (Leon)

Browns (*continued.*)

*Nankin, (B), (By.)
New Acid Brown, (B S & Spl)
New Golden Brown A1, (C.)
Resorcine Brown, (Ber.), (D.),(W Bros)
,, ,, A, (R.H. & S.)
*Vesuvine OOO, (B),(M.L. & B.)
* ,, 4DG. Conc., (M.L & B.)

YELLOWS.

Acid Yellow FY, (R. H. & S)
Acid Phosphine J O, (C.)
*Auramine II, (B), (Ber.), (By.), (C.), (C.A.), (C.& R), (K.), (Leon), (M L.& B.), (O.), (R.H.& S.), (S.A.), (S.C.I.), (W Bros.),&c.
Azo Flavine 3R, (W. t. M.)
Azo Yellow G, (W. t. M.)
Cuba Yellow, (C.), (S.C.I.), (W. Bros)
Indian Yellow J, (R. H. & S.)
,, ,, R, (By.), (C.)
Naphthol Yellow, (B.), (By.), (C.)
Quinoline Yellow, (B.), (Ber.), (By.), (C.) (R. H. & S.)
*Rheonine, (B.)

* Basic Colours.

Acid and Basic Colours Suitable for Dyeing and Staining Alum Kid (*continued.*)

GREENS.

Acid Green, (B.), (Ber.), (By.), (C.), (C.A.), (C.& R.), (K.), (Leon.) (M.L & B), (O.), (R H.& S), (S.A.), (S.C.I.), (W Bros.), &c.
Acid Green, 2BG , (W. t. M.)
Diamond Green B, (B)
Guinea Green B.& G., (Ber.)
Malachite Green Cryst., (W. t. M.)

BLUES.

Acid Blue IV., (R.H. & S.)
Cyanole Extra, (C)
Disulphine Blues (R.H. & S.)
*Methylene Blue, (Ber), (M.L.& B)
* ,, ,, B, (R.H. & S)
Solid Blue D, (C.)

DYES SUITABLE FOR DYEING CHAMOIS LEATHER.

ACID AND BASIC COLOURS.

Acid Brown B,R, (R H. & S)
,, ,, B. & Y, (S C.I.)
Acid Green, (M L.& B)
,, ,, BB Ext., (By)
,, ,, conc , (M.L & B.)
,, ,, G, (By)
,, ,, 2G, (W. t M)
,, ,, GG. (R.H. & S)
Archil Brown G, (By.)
Azo Acid Brown, (By.)
Azo Brown V, (M L & B.)
Azo Flavine 3R, (W. t M.)
,, ,, RS, (B), (C)
Azo Phosphine, (Uer.)
Azo Yellow 3G, (W. t. M)
,, ,, R, (M L & B)
*Bismark Brown, (Ber), (R.H. & S)
* ,, ,, Ext , (Ber.)
* ,, ,, F & M, (By)
Blue PP, (Ber.)
Bronze Acid Brown, (By.)
*Cannella for Leather, (By.)
Chocolate, (Uer.)
*Chrysoidine G pdr., (By.)
* ,, R. Y, (R.H. & S.)
Curcumeine Ext., (Ber.)
Crimson Yellow Shade, (By.)
Crocein Scarlet 2 BN, (By.)
Dark Brown, (C.)
,, ,, B, (By.)
Dark Nut Brown, (Uer.)
*Fashion Brown, GO, R, RO, (By.)
Fast Acid Yellow, (C.A.)
Fast Brown, (By.)
,, ,, N, (B.)
Golden Brown, (Lei.)
Golden Brown, Y, (C)
Golden Yellow, (By.)
Grey Bluish, (G.)
,, Yellowish, (G.)
*Havannah Brown RG, (By)
Indian Yellow G, (By.)
,, ,, J, (R.H. & S)
Induline A, (R.H. & S.)
,, NW, (B.)
Jet Black Cryst., (C.)
*Lavalliere 1, II, (By)
Leather Blue V, (G)
* ,, Brown A, (S C.I.)
* ,, ,, F, (By.)
* ,, ,, GG, (By.)
* ,, ,, Y, (S.C.I.)
* ,, Yellow, (C.A.)
* ,, ,, O Ext., (By.)
Naphthalene Black, (R.H. & S.)
Naphthylamine Black 4B, (C), (O.)
,, ,, 6B, (C.)
New Victoria Black B, (By.)
*Night Blue, (B)
Nigrosine G, (R.H. & S.)
,, LT, (By.)
,, (W. t. M.)
Orange II, (M.L. & B.)
Paper Black T, (By.)
*Philadelphia Brown, (Ber.)
*Philadelphia Yellow R, (Ber.)
*Pure Phosphine, (C.)
Resorcine Brown A, (R.H.& S.)
,, ,, (Ber.)
Silver Grey N, (C.)
Victoria Black B. & G., (By.)

* Basic Colours.

Dyes Suitable for Dyeing Chamois Leather (*continued.*)

ALIZARINE COLOURS.

Acid Anthracene Brown R, (By.)
,, ,, ,, G, (By.), (C.)
Alizadine Brown R (R.H. & S.)
,, Orange R, (R. H. & S.)
,, Yellow Y, 2R, (R. H. & S.)
Alizarine Black, (C.)
,, Blue, (B.)
,, ,, PP, (D & H.)
,, ,, 2OX, (B)
,, Brown Paste, (M L.& B.)
,, Corcian AB, (Ber)
,, Cyanine E Ext , (By.)
,, ,, Green G Ext , (By)
,, Orange W, (By)
,, Orange Paste 2OR,(M.L.& B)
,, Red, WB, (B.)
,, Yellow 3G, (By.)
Anthracene Blue WG, (By.)
,, Brown, (B.)
,, ,, Paste W, (R. H & S.)
,, GG, (By.)
,, Paste, (M.L.& B.)
,, R, (By.)
,, W, (By.)
Azo Alizarine Black 1, (D. & H.)
,, ,, Blue RP2O, (D. & H.)
,, ,, Brown, (D. & H.)
,, ,, Yellow, (Ber.), (D. & H)
Brilliant Alizarine Cyanine, (By)
Coerulein, (B.)
Corcian RR, (Ber.)
Gallazine, (Ber.)
Mordant Yellow O, (M.L.& B)
,, ,, Y, (R. H. & S.)

DIRECT COLOURS.

Cotton Blue III, (By.)
Crumpsall Yellow RFP, (Lev.)
Diamine Black BH, (C.)
,, Orange B, (C.)
Milling Brown, (Leon.)
Renolamine Black BH, (W. t. M.)

JANUS COLOURS.

Janus Blue B, (M.L.& B.)
,, Brown R, (M.L & B.)
,, Claret Red B, (M.L.& B.)
,, Green G, (M.L & B.)
,, Red B, (M.L.& B.)
,, Yellow, (M L & B.)
,, ,, G, (M L.& B.)
,, ,, R, (M.L.& B.)

Appendix B.

The Fading of Colour from Sumach-tanned Leather Dyed with Coal-tar Colours.

IN order to determine the relative permanence of the various coal-tar colours as regards light, about 1500 pieces of sumach-tanned leather were dyed, each with its special dye-stuff, as supplied by the principal German, Swiss, French and English manufacturers, and were arranged on boards placed horizontally and exposed to light in a glass-house situated in the Botanical Society's Gardens in Regent's Park, London, kindly lent for the purpose by the Royal Botanic Society; half of each pattern being carefully protected from the light, whilst the other halves of the pieces were fully exposed to it. To obtain a standard by which to judge the fading of the colours, six much larger pieces of leather were dyed in colours, say, A, B, C, D, E and F, known to be not very fast to light, and six sample pieces cut from these, one from each, were exposed along with the 1500. At the end of nine days of bright sunlight, it was found that the colour of the sample cut, say, from D piece, had just faded.

The pieces of dyed leather were then examined, and all those noted that had faded in this first "period."

A second sample from the D piece was now exposed; the period of its fading being, let us suppose a month, the conditions of weather not being so favourable for bright sunlight Again, note was made of the colours among the pieces that had faded up to the end of this time, which was counted as a second period. In all, before the investigation came to a conclusion, ten such periods of equal sunshine value to the original nine days, but extending in all over thirteen months, were completed. At the end of that time all the colours had faded.

Along with the dyed pieces of the leather, undyed samples from the same skins were also exposed that the effect of light upon the colour of the leather, as tanned only, might be ascertained. At the end of the full interval of thirteen months, the colour had perceptibly darkened. In judging of the fading of the dyed pieces allowance was made for this darkening.

In dyeing the leather with the acid colours, sulphuric acid was added to the dye-bath. For dyeing with the basic colours, the excess of tannic acid in the leather was fixed in an insoluble form by treatment of the leather previous to dyeing with a bath of tartar emetic and common salt.

Upon completion of the above investigation further patterns were dyed with acid colours, using formic acid as an addition to the dye-bath, as a substitute for sulphuric acid (the latter being injurious to the leather, see page 55). It was found that the fading behaved in exactly the same manner as when the sulphuric acid was used.

Leather dyed with mixtures of the various coal-tar colours was also exposed to light (Society of Chemical Industry Journal, November 1908). In every case it was noted that the fading proceeded at the same rate as when the single colouring matter was employed; that is to say, when a shade produced by a mixture of a fugitive and a fast colour was exposed, the fugitive colour faded, leaving the fast colour unaffected.

Formaldehyde was tried as an addition to the dye-bath when dyeing with basic colours; but the addition did not have any effect upon the rate of fading.

The following are the lists of colours which faded in the various "periods," those lasting to the tenth period being, of course, the most permanent.

PERIOD 1.

After exposure to light from July 14th to July 23rd (number of days inclusive = 9), the colour had entirely faded from the leather.

Circumein.	Erythrosine.
Eosine OO.	Methyl Eosine.
Eosine YS.	Napthol Green B.
Eosine BS.	Phloxine BT.
Eosine A	Phloxine N.

PERIOD 2.

After exposure to light from July 14th to August 14th (number of days inclusive = 31), the colour had entirely faded from the leather.

Acid Violet 6B.	Fast Green Ext.	Russian Red G.
Acid Violet RS.	Imperial Green G1.	Russian Red 2C
Acid Violet 2B	Imperial Green G2	Russian Red R.
Benzo Flavine.	Imperial Green G3	Solid Green B.
Brilliant Green.	Malachite Green	Solid Green Cryst.
China Green.	Methyl Violet 2	Solid Green Cryst O
Chrysoidine RE.	Naphthol Yellow S	Turquoise Blue BB.
Chrysoidine AG.	Orange 4	Turquoise Blue G
Chrysoidine O.	Rheonine N.	Titan Brown R.
Chrysoidine J.	Rose Bengal.	Ultramarine Blue
Citronine A	Russian Green BB	Vesuvine.
Emerald Green.	Russian Green G.	Vesuvine B.
Fast Acid Green BN	Russian Green Y.	

PERIOD 3.

After exposure to light from July 14th to September 21st (number of days inclusive = 69), the colour had entirely faded from the leather.

Acid Green 3B.	Cannella NW.	Lavilliere 1.
Acid Yellow.	Cannella Y.	Lazuline Blue R.
Alkali Blue 6R.	Cannella P.	Light Green N.
Alkali Blue 6B.	Cerise A.	Methyl Green.
Acridine Scarlet 3R.	Chrysoidine G.	Naphthol Yellow
Acridine Scarlet R.	Chrysoidine R.	Neptune Green S.
Archil Substitute N.	Chrysoidine Y.	Phosphine 3RB.
Auramine 2.	Chrysoidine YY.	Phosphine B Ext.
Auramine O.	Chrysoidine Cryst.	Phosphine 3.
Auramine G.	Cotton Blue R.	Phosphine 2.
Bismark Brown GG.	Corvoline G.	Phosphine 1.
Bismark Brown NYY	Crumpsall Yellow FRP.	Phosphine N.
Bismark Brown F.	Crumpsall Yellow YYP.	Phosphine 3R.
Bismark Brown M.	Diamond Blue 3R.	Phosphine NA.
Bismark Brown PS.	Diamond Green B.	Phosphine GA.
Bismark Brown FW	Ethyl Green.	Philadelphia Yellow G.
Bismark Brown R.	Eboli Green G.	Philadelphia Yellow QR
Bismark Brown O	Fast Acid Blue B.	Philadelphia Brown.
Bordeaux B.	Fast Acid Violet 4B.	Turmeric Yellow.
Cannella PW.	Formyl Violet 8, 4B.	Thioflavine T.
Cannella L.	Fast Acid Magenta B.	Vesuvine Conc.
Cannella OF.	Lavilliere 2.	

PERIOD 4.

After exposure to light from July 14th to November 15th (number of days inclusive = 124), the colour had entirely faded from the leather.

Acid Brown R.
Acid Brown B.
Acid Violet 3BN.
Acid Violet BN
Acid Violet FS.
Acid Green Ext.
Acid Green BB Ext
Acid Green GG Ext
Acid Green 225.
Acid Green O.
Acid Green Conc
Acid Blue Green Shade
Acridine Red B
Acridine Red 3B
Acridine Red 2B
Aniline Yellow 2.
Azo Acid Violet R Ext
Azo Acid Violet B
Atlas Scarlet 1
Azo Cochineal.
Bordeaux Extra.
Bordeaux Y.
Bismark Brown Y
Bismark Brown Y Ext
Bismark Brown 30R
Bismark Brown 2B
Bismark Brown YS
Cardinal 4B.
Carnation M.
Chrysoidine Ext
Cuba Yellow
Corvoline B.
Chrysophenine G
Cyanole Ext
Cerise D2
Cerise N.
Cresyl Fast Blue 2B.
Crimson N.
Dahlia.
Diamond Magenta.
Eboli Green B.
Fast Brown 3B.
Fast Navy Blue BM.
Fast Navy Blue A.
Golden Yellow.
Guinea Green B.
Guinea Green G.
Grenadine G.
Indian Yellow T
Indian Yellow G
Indigo Blue L.
Indigo Blue N
Magenta WB
Magenta RF.
Magenta WBG.
Methyl Blue
Methyl Green YS
Methyl Violet 4R.
Methyl Violet C.
Methyl Violet 6B.
Methyl Violet 3R.
Methyl Violet R
Methyl Violet 3B.
Methyl Violet B Ext.
Methyl Violet 2B.
Methyl Violet BB.
Methyl Violet BO.
Maroon.
Magenta Scarlet B.
Magenta Scarlet G.
Marine Blue.
New Golden Brown A1
New Patent Blue GA.
Naphthol Blue G.
New Victoria Black G.
New Blue B.
Neutral Violet.
New Magenta O.
New Metamine Blue.
Naphthylamine Black R.
Nanking.
Naphthol Blue Black N.
Orange GG.
Phosphine E.
Phosphine L
Phosphine G.
Phosphine R.
Phosphine WA
Phosphine 2A.
Patent Phosphine GG
Pure Blue Cryst.
Philadelphia Black B.
Pyronine G
Russian Red R
Russian Red GG.
Russian Red B
Russian Red GR
Resorcin Yellow
Rosaniline Cryst.
Rubin
Scarlet G
Scarlet R.
Solid Green CE.
Solid Yellow B
Soluble Blue GS
Soluble Blue R.
Soluble Blue B.
Violet Cryst O.
Xanthine 3GO

PERIOD 5.

After exposure to light from July 14th to January 20th (number of days inclusive - 190), the colour had entirely faded from the leather.

Acid Brown L.
Acid Phosphine JO.
Acid Maroon.
Acid Brown RR
Acid Brown D.
Acid Brown Y.
Acid Green 4B.
Acid Violet R.
Acridine Orange NO.
Amaranth.
Anthracene Acid Brown G.
Atlas Orange YS.
Atlas Orange RS.
Atlas Scarlet 3.
Auramine Conc.
Azo Acid Brown.
Azo Crimson L.
Azo Flavine 7032.
Azo Fuchsine GW Ext.
Azo Phosphine.
Azo Rubine S.
Azo Yellow 3R.
Azo Yellow R.
Bismark Acid Brown.
Brill Scarlet B.
Brill Scarlet 4RB.
Brill Scarlet YY.
Brill Scarlet Y.
Bronze Acid Brown.
Capri Blue GO.
Capri Green 2G.
Cardinal 1.
Cardinal 3B.
Carmosine Orange A.
Cotton Blue OO.
Croceine Scarlet B.
Croceine Scarlet R.
Double Ponceau 2R.
Double Ponceau 4R.
Eclipse Blue.
Erioglaucine.
Fast Blue E1.
Fast Blue O.
Fast Brown G.
Fast Brown N.
Fast Navy Blue RM.
Fast Red A.
Fast Red Ext.

Fast Red PR Ext.
Fast Violet BS.
Fram Blue G.
Golden Brown Y.
Golden Orange.
Homophosphine G.
Induline B.
Mandarine B Ext.
Methyl Blue.
Naphthol Brown.
Naphthylamine Black 4B.
Naphthylamine Black 6B.
Naphthylamine Brown.
New Blue R.
New Phosphine.
Nigrosine GO.
Nigrosine R.
Nigrosine W.
Orange S.
Orange 2.
Orange 2B.
Orange P.
Orange G.
Orange GT
Orange N.
Orange Ext.
Orange Ext. Conc.
Orange A.
Patent Phosphine 3R.
Phosphine Yellow R.
Ponceau 4GB.
Ponceau 3R Ext.
Ponceau 2R.
Ponceau Y.
Pure Blue P.
Rhodamine 6GN.
Safranine G Ext. C.
Safranine Ext.
Scarlet B.
Scarlet Y.
Scarlet 3R.
Scarlet BB.
Scarlet G1
Solid Blue G
Victoria Black G
Water Blue 3B

PERIOD 6.

After exposure to light from July 14th to April 12th (number of days inclusive = 272), the colour had entirely faded from the leather.

Acid Green 5677.
Acid Violet 3BA
Azo Bordeaux.
Azo Fuchsin B.
Atlas Scarlet 6.
Bordeaux 3B.
Burmese Red.
Brill Croceine MOO.
Cochineal Scarlet PS.
Croceine Scarlet B.
Croceine Scarlet 6R.
Curcumein Extra.
Dark Nut Brown
Fast Red KG.
Induline A
Induline L.
Methylene Blue B
Milling Red R.
Nigrosine LT.
Nigrosine JB.
New Phosphine Pure.
New Patent Blue 4B
New Claret L
Ponceau 10RB.
Ponceau 4R.
Ponceau BO.
Ponceau 4RB.
Ponceau 6RB
Safranine AG Ext
Safranine 2.
Scarlet 4R.
Solid Brown O.
Sloeline BS
Victoria Black
Wool Ponceau LR.

PERIOD 7.

After exposure to light from July 14th to May 4th (number of days inclusive = 294), the colour had entirely faded from the leather.

Acid Magenta O, (M L.& B)
Acid Magenta (R.H & S)
Archil Red A, (B)
Azo Bordeaux, (By)
Azo Crimson S, (By.)
Azo Flavine RS, (C.), (B)
Azo Yellow BS, (Uer)
Bordeaux B Ext., (By)
Bordeaux BL, (B.)
Bordeaux Y, (By.)
Brill Croceine 3B, (By.)
Croceine Scarlet 8B, (By)
Croceine Scarlet 7B, (By)
Claret Red B, (M.L.& B)
Cotton Blue 2, (By.)
Cuba Yellow, (W. Bros.), (C)
Croceine AZ, (C.)
Fast Milling Red B. (Leon.)
Flavinduline 2, (B.)
Fast Scarlet B, (B.), (W. Bros.)
Induline NW, (B.)
Indian Yellow R, (By.)
Light Blue SF, (B.)
Methylene Blue BB, (By)
Methylene Blue 2R, (Ber.)
Naphthylamine Brown, (B.)
Phenol Black SS, (By)
Phosphine Substitute, (C & K.)
Quinoline Yellow, (B.)
Resorcine Brown, (Ber)
Rhodamine B, (By)
Safranine FF Ext., (By.)
Safranine 1 Extra, (B.)
Safranine T, (B.)
Safranine Scarlet B, (B.)
Scarlet EC, (C.)
Solid Blue R, (M.L.& B.)
Solid Yellow G, (Leon.)
Tartrazine, (B.)
Turmeric Substitute, (W. Bros.)
Victoria Black B, (By.)
Water Blue R, (Leon.)
Water Blue 3R, (Leon.)
Water Blue BTR, (B.)
Water Blue PP, (B.)
Water Blue BB, (Ber.)

PERIOD 8.

After exposure to light from July 14th to June 1st (number of days inclusive = 322), the colour had entirely faded from the leather.

Azo Fuchsine S, (By.)
Azo Acid Magenta B, (M L.& B.)
Bavarian Blue DB, (Ber.)
Bordeaux G, (Ber), (By)
Brill Safranine G, (Ber)
Brill Safranine O, (M L & B)
Brill Rhoduline Red, (By)
Chromotrope 6B, (M.L.& B)
Cotton Blue BB, (B)
Cotton Blue I, (By)
Cresyl Blue 2BS, (Leon)
Chromotrope 2R, (M L & B)
Fast Blue R, (B)
Fast Red S, (M L.& B)
Induline R, (By)
Imperial Scarlet, (By.)
New Methylene Blue N, (C)
New Methylene Blue GG, (C)
New Methylene Blue BB, (C)
Nigrosine B, (By)
Ponceau GRB, (Ber.)
Rhodamine B Extra, (B.)
Swiss Blue R, (R H.& S.)
Scarlet B Extra, (M.L & B)
Victoria Black Blue, (By.)
Violamine R, (M L.& B)
Water Blue 4B, (Leon)
Water Blue 6B, (Ber.)

PERIOD 9 and 10.

After exposure to light from July 14th to August 15th (number of days inclusive – 397), the colour had entirely faded from the leather.

Violamine B, (M.L & B)
Nigrosine WG, (B)
Fast Blue 5B, (B)
Acid Violet 4R, (B.)

Appendix C.

SPECIFIC GRAVITIES AND VARIOUS TABLES.

Specific Gravity of Solutions of Pyrolignite of Iron (Iron Acetate) at 18°.

Specific Gravity.	Grams Fe_2O_3 per litre.	Specific Gravity.	Grams Fe_2O_3 per litre.
1·274	190	1·137	95
1·266	185	1·130	90
1·258	180	1·123	85
1·250	175	1·116	80
1·242	170	1·109	75
1·235	165	1·102	70
1·228	160	1·095	65
1·221	155	1·088	60
1·214	150	1·081	55
1·207	145	1·074	50
1·200	140	1·067	45
1·193	135	1·060	40
1·186	130	1·053	35
1·179	125	1·046	30
1·172	120	1·039	25
1·165	115	1·032	20
1·158	110	1·025	15
1·151	105	1·018	10
1·144	100	1·010	5

Specific Gravity of Solutions of Ferrous Sulphate at 15°.

Specific Gravity	Percentage $FeSO_4 + 7H_2O$	Specific Gravity.	Percentage $FeSO_4 + 7H_2O$
1·011	2	1·082	15
1·021	4	1·112	20
1·032	6	1·143	25
1·043	8	1·174	30
1·054	10	1·206	35
1·065	12	1·239	40

Specific Gravity of Solutions of Sodium Bisulphite at 15°.

Specific Gravity.	Percentage $NaHSO_3$.	Percentage SO_2.
1·008	1·6	0·4
1·022	2·1	1·3
1·038	3·6	2·2
1·052	5 1	3·1
1·068	6·5	3·9
1·084	8·0	4·8
1·100	9·5	5·7
1·116	11·2	6·8
1·134	12·8	7·8
1·152	14·6	9·0
1·171	16·5	10·2
1·190	18·5	11·5
1·210	20·9	12·9
1·230	23·5	14·5
1·252	25·9	15·9
1 275	28·9	17·8
1·298	31·7	19·6
1·321	34·7	22·5
1·345	38·0	23·6

Specific Gravity of Solutions of Tartar Emetic at 17·5° (*Streit*).

Specific Gravity	Percentage Tartar Emetic.	Specific Gravity.	Percentage Tartar Emetic.	Specific Gravity.	Percentage Tartar Emetic.
1·005	0·5	1·015	2·5	1·031	4·5
1·007	1·0	1·018	3·0	1·035	5·0
1·009	1·5	1·022	3·5	1·038	5·5
1·012	2·0	1·027	4·0	1·044	6·0

Specific Gravity of Solutions of Copper Sulphate at 17°.

Specific Gravity.	Percentage $CuSO_4+5H_2O$.	Specific Gravity.	Percentage $CuSO_4+5H_2O$.
1·0126	2	1·0933	14
1·0254	4	1·1063	16
1·0384	6	1·1208	18
1·0516	8	1·1354	20
1·0649	10	1·1501	22
1·0785	12	1·1659	24

Table of Percentage of Sulphuric Acid (*Lunge* and *Isler*).

Specific Gravity.	Degree Twaddell.	Percentage. H_2SO_4	Specific Gravity.	Degree Twaddell.	Percentage. H_2SO_4
1·080	16	11·60	1·600	120	68·51
1·090	18	12·99	1·610	122	69·43
1·100	20	14·35	1·620	124	70·32
1·110	22	15·71	1·630	126	71·16
1·120	24	17·01	1·640	128	71·99
1·130	26	18·31	1·650	130	72·82
1·140	28	19·61	1·660	132	73·64
1·150	30	20·91	1·670	134	74·51
1·160	32	22·19	1·680	136	75·42
1·170	34	23·47	1·690	138	76·30
1·180	36	24·76	1·700	140	77·17
1·190	38	26·04	1·710	142	78·04
1·200	40	27·32	1·720	144	78·92
1·210	42	28·58	1·730	146	79·80
1·220	44	29·84	1·740	148	80·68
1·230	46	31·11	1·750	150	81·56
1·240	48	32·28	1·760	152	82·44
1·250	50	33·43	1·770	154	83·32
1·260	52	34·57	1·780	156	84·50
1·270	54	35·71	1·790	158	85·70
1·280	56	36·87	1·800	160	96·90
1·290	58	38·03	1·810	162	88·30
1·300	60	39·19	1·820	164	90·05
1·310	62	40·35	1·821	...	90·20
1·320	64	41·50	1·822	...	90·40
1·330	66	42·66	1·823	...	90·60
1·340	68	43·74	1·824	...	90·80
1·350	70	44·82	1·825	165	91·00
1·360	72	45·88	1·826	...	91·25
1·370	74	46·94	1·827	...	91·50
1·380	76	48·00	1·828	...	91·70
1·390	78	49·06	1·829	...	91·90
1·400	80	50·11	1·830	166	92·10
1·410	82	51·15	1·831	...	92·30
1·420	84	52·15	1·832	...	92·52
1·430	86	53·11	1·833	...	92·75
1·440	88	54·07	1·834	...	93·05
1·450	90	55·03	1·835	167	93·43
1·460	92	55·97	1·836	...	93·80
1·470	94	56·90	1·837	...	94·20
1·480	96	57·83	1·838	...	94·60
1·490	98	58·74	1·839	...	95·00
1·500	100	59·70	1·840	168	95·60
1·510	102	60·65	1·8405	...	95·95
1·520	104	61·59	1·8410	..	97·00
1·530	106	62·53	1·8415	...	97·70
1·540	108	63·43	1·8410	...	98·20
1·550	110	64·26	1·8405	...	98·70
1·560	112	65·08	1·8400	168	99·20
1·570	114	65·90	1·8395	...	99·45
1·580	116	66·71	1·8390	...	99·70
1·590	118	67·59	1·8385	...	99·95

Comparative Hydrometer Scale, Sp. Gr., Twaddell, and Baumé, at 12·5° C.

Twaddell.	Baumé.	Specific Gravity.	Twaddell.	Baumé.	Specific Gravity.
0	0	1·000	54	30·6	1·270
1	0·7	1·005	55	31·1	1·275
2	1·4	1·010	56	31·5	1·280
3	2·1	1·015	57	32·0	1·285
4	2·7	1·020	58	32·4	1·290
5	3·4	1·025	59	32·8	1·295
6	4·1	1·030	60	33·3	1·300
7	4·7	1·035	61	33·7	1·305
8	5·4	1·040	62	34·2	1·310
9	6·0	1·045	63	34·6	1·315
10	6·7	1·050	64	35·0	1·320
11	7·4	1·055	65	35·4	1·325
12	8·0	1·060	66	35·8	1·330
13	8·7	1·065	67	36·2	1·335
14	9·4	1·070	68	36·6	1·340
15	10·0	1·075	69	37·0	1·345
16	10·6	1·080	70	37·4	1·350
17	11·2	1·085	71	37·8	1·355
18	11·9	1·090	72	38·2	1·360
19	12·4	1·095	73	38·6	1·365
20	13·0	1·100	74	39·0	1·370
21	13·6	1·105	75	39·4	1·375
22	14·2	1·110	76	39·8	1·380
23	14·9	1·115	77	40·1	1·385
24	15·4	1·120	78	40·5	1·390
25	16·0	1·125	79	40·8	1·395
26	16·5	1·130	80	41·2	1·400
27	17·1	1·135	81	41·6	1·405
28	17·7	1·140	82	42·0	1·410
29	18·3	1·145	83	42·3	1·415
30	18·8	1·150	84	42·7	1·420
31	19·3	1·155	85	43·1	1·425
32	19·8	1·160	86	43·4	1·430
33	20·3	1·165	87	43·8	1·435
34	20·9	1·170	88	44·1	1·440
35	21·4	1·175	89	44·4	1·445
36	22·0	1·180	90	44·8	1·450
37	22·5	1·185	91	45·1	1·455
38	23·0	1·190	92	45·4	1·460
39	23·5	1·195	93	45·8	1·465
40	24·0	1·200	94	46·1	1·470
41	24·5	1·205	95	46·4	1·475
42	25·0	1·210	96	46·8	1·480
43	25·5	1·215	97	47·1	1·485
44	26·0	1·220	98	47·4	1·490
45	26·4	1·225	99	47·8	1·495
46	26·9	1·230	100	48·1	1·500
47	27·4	1·235	101	48·4	1·505
48	27·9	1·240	102	48·7	1·510
49	28·4	1·245	103	49·0	1·515
50	28·8	1·250	104	49·4	1·520
51	29·3	1·255	105	49·7	1·525
52	29·7	1·260	106	50·0	1·530
53	30·2	1·265			

To convert degrees Tw. into sp. gr., multiply by 5, add 1000, and divide by 1000.

Appendix D.

USEFUL DATA.

CONVERSION OF GRAMMES PER LITRE INTO OUNCES PER GALLON.

Per litre.		Per gallon.		Per gallon.		
grms. 1	=	4½ grms.	=	⅙ oz.		
,, 2	=	9 ,,	=	⅓ ,,		
,, 3	=	13½ ,,	=	½ ,,		
,, 4	=	18 ,,	=	⅔ ,,		
,, 5	=	22½ ,,	=	⅚ ,,		
,, 6	=	27 ,,	=	1 ,,		
,, 7	=	31½ ,,	=	1⅙ ,,		
,, 8	=	36 ,,	=	1⅓ ,,		
,, 9	=	40½ ,,	=	1½ ,,		
,, 10	=	45 ,,	=	1⅔ ,,		
,, 11	=	49½ ,,	=	1⅚ ,,		
,, 12	=	54 ,,	=	2 ,,		
,, 13	=	58½ ,,	=	2⅙ ,,		
,, 14	=	63 ,,	=	2⅓ ,,		
,, 15	=	67½ ,,	=	2½ ,,		
,, 16	=	72 ,,	=	2⅔ ,,		
,, 17	=	76½ ,,	=	2⅚ ,,		
,, 18	=	81 ,,	=	3 ,,		
,, 19	=	85½ ,,	=	3⅙ ,,		
,, 20	=	90 ,,	=	3⅓ ,,		
,, 30	=	135 ,,	=	5 ,,		
,, 40	=	180 ,,	=	6⅔ ,,		
,, 50	=	225 ,,	=	8⅓ ,,		
,, 60	=	270 ,,	=	10 ,,		
,, 70	=	315 ,,	=	11⅔ ,,		
,, 80	=	360 ,,	=	13⅓ ,,		
,, 90	=	405 ,,	=	15 ,,		
,, 100	=	450 ,,	=	16⅔ ,,		
,, 200	=	900 ,,	=	33⅓ ,,	=	2 lbs. 1⅓ ozs.
,, 300	=	1350 ,,	=	50 ,,	=	3 ,, 2 ,,
,, 400	=	1800 ,,	=	66⅔ ,,	=	4 ,, 2⅔ ,,
,, 500	=	2250 ,,	=	83⅓ ,,	=	5 ,, 3⅓ ,,

1 lb. = 16 ozs. = 256 drams = 7000 grains = 453·6 grams.
1 oz. = 16 drams = 437·5 grains = 28·35 grams.
1 gram = 15·43 grains. 1 grain = 0·0645 grams.
1 kilogram = 35·27 ounces = 2·2 lbs.
1 pint = 2 gills = 4 noggins = 1¼ lbs.
1 quart = 2 pints = 4 gills = 8 noggins = 2½ lbs.
1 gallon = 4 quarts = 8 pints = 16 gills = 32 noggins = 10 lbs.
1 gallon = 4·5 litres.
1 litre = 0·22 gallons = 1·76 pints = 35·2 fluid ozs.
1 pint = 568 cc = 20 fluid ozs.
1 fluid oz. = 28·4 cc.

APPROXIMATE WEIGHT OF ONE PINT OF VARIOUS COMMERCIAL CHEMICALS.

			LBS.	OZS.
1 pint	Ammonia (Sp. Gr. ·880)	weighs about	1	1½
,,	Acetic Acid (Glacial)	,, ,,	1	5
,,	,, ,, (29%)	,, ,,	1	4¾
,,	Formic Acid (40%)	,, ,,	1	6
,,	,, ,, (60%)	,, ,,	1	6¾
,,	Lactic Acid (Sp. Gr. 1·2)	,, ,,	1	8
,,	Muriatic Acid (Hydrochloric coml.) ...	,, ,,	1	7
,,	Nitric Acid	,, ,,	1	11½
,,	Sulphuric Acid (D.O.V.)	,, ,,	2	4
,,	,, ,, (C.O.V. Sp. Gr. 1·73) ...	,, ,,	2	3¾
,,	Bisulphite of Soda (52° Tw.)	,, ,,	1	9
,,	,, ,, ,, (80° Tw.)	,, ,,	1	12
,,	Caustic Soda (45° Bé.)	,, ,,	1	12
,,	Glycerine (Sp. Gr. 1·265)	,, ,,	1	9¾
,,	Iron Liquor (42° Bé.)	,, ,,	1	11½
,,	Methylated Spirits (Sp. Gr. ·83) ...	,, ,,	1	0½
,,	Castor Oil	,, ,,	1	3
,,	Cod Oil	,, ,,	1	2½
,,	Linseed Oil	,, ,,	1	2¾
,,	Neatsfoot Oil	,, ,,	1	2¼
,,	Sperm Oil	,, ,,	1	1½

CONVERSION OF GRAINS, OZS., LBS., QRS., CWTS. INTO KILOGRAMS.

7·716175 grains = 0·5 grams.
15·432350 ,, = 1·0 ,,
154·323500 ,, = 10·0 ,,
437½ grains = 1 oz. = 28$\frac{3}{10}$ grams.
16 oz. = 1 lbs. = 453·59 ,,
28 lbs = 1 qrs. = 12 kilos 712 grams.
4 qrs = 1 cwt. = 112 lbs. = 50 kilos 803 grams.
20 cwts. = 1 ton = 1016·06 kilos.

1 oz. =	437½ grains	=	28·3502	grams.
2 ,, =	875 ,,	=	56·6991	,,
3 ,, =	1312½ ,,	=	85·0486	,,
4 ,, =	1750 ,,	=	113·3981	,,
5 ,, =	2187½ ,,	=	141·7482	,,
6 ,, =	2625 ,,	=	170·0972	,,
7 ,, =	3062½ ,,	=	198·4466	,,
8 ,, =	3500 ,,	=	226·7962	,,
9 ,, =	3937½ ,,	=	255·1457	,,
10 ,, =	4375 ,,	=	283·4952	,,
11 ,, =	4812½ ,,	=	311·8448	,,
12 ,, =	5250 ,,	=	340·1942	,,
13 ,, =	5687½ ,,	=	368·5438	,,
14 ,, =	6125 ,,	=	396·8933	,,
15 ,, =	6562½ ,,	=	425·2428	,,
16 ,, =	7000 ,,	=	453·5923	,,

1 milligram	=	0·001	grams.
1 centigram	=	0·01	,,
1 decigram	=	0·1	,,
1 decagram	=	10·000	,,
1 hectogram	=	100·000	,,
1 kilogram	=	1000·000	,,

Thermometric Scales.

There are two different thermometric scales used in this country, namely, the Centigrade and the Fahrenheit. The two scales are mutually convertible by the following formulæ in which F° represents a temperature on the Fahrenheit scale and C° a temperature of the Centigrade scale:—

$$F^\circ = \frac{9C^\circ}{5} + 32$$

$$C^\circ = \frac{5\,(F^\circ - 32)}{9}$$

Equivalents in Centigrade and Fahrenheit.

C. Deg.	F. Deg.	C. Deg.	F. Deg.	C. Deg.	F. Deg.	C. Deg.	F. Deg
·6 ...	21·2	21 ...	69·8	48 ...	118·4	75 ...	167·0
·5 ...	23·0	22 ...	71·6	49 ...	120·2	76 ...	168·8
·4 ...	24·8	23 ...	73·4	50 ...	122·0	77 ...	170·6
·3 ...	26·6	24 ...	75·2	51 ...	123·8	78 ...	172·4
·2 ...	28·4	25 ...	77·0	52 ...	125·6	79 ...	174·2
1 ...	30·2	26 ...	78·8	53 ...	127·4	80 ...	176·0
·0 ...	32·0	27 ...	80·6	54 ...	129·2	81 ...	177·8
1 ...	33·8	28 ...	82·4	55 ...	131·0	82 ...	179·6
2 ...	35·6	29 ...	84·2	56 ...	132·8	83 ...	181·4
3 ...	37·4	30 ...	86·0	57 ...	134·6	84 ...	183·2
4 ...	39·2	31 ...	87·8	58 ...	136·4	85 ...	185·0
5 ...	41·0	32 ...	89·6	59 ...	138·2	86 ...	186·8
6 ...	42·8	33 ...	91·4	60 ...	140·0	87 ...	188·6
7 ...	44·6	34 ...	93·2	61 ...	141·8	88 ...	190·4
8 ...	46·4	35 ...	95·0	62 ...	143·6	89 ...	192·2
9 ...	48·2	36 ...	96·8	63 ...	145·4	90 ...	194·0
10 ...	50·0	37 ...	98·6	64 ...	147·2	91 ...	195·8
11 ...	51·8	38 ...	100·4	65 ...	149·0	92 ...	197·6
12 ...	53·6	39 ...	102·2	66 ...	150·8	93 ...	199·4
13 ...	55·4	40 ...	104·0	67 ...	152·6	94 ...	201·2
14 ...	57·2	41 ...	105·8	68 ...	154·4	95 ...	203·0
15 ...	59·0	42 ...	107·6	69 ...	156·2	96 ...	204·8
16 ...	60·8	43 ...	109·4	70 ...	158·0	97 ...	206·6
17 ...	62·6	44 ...	111·2	71 ...	159·8	98 ...	208·4
18 ...	64·4	45 ...	113·0	72 ...	161·6	99 ...	210·2
19 ...	66·2	46 ...	114·8	73 ...	163·4	100 ...	212·0
20 ...	68·0	47 ...	116·6	74 ...	165·2		

ERRATA.

Page 54. Line 12 from top. For '§1040' *read* 'p. 412.'

„ 69. „ 12 from bottom. „ 'red litmus' *read* 'blue litmus.'

„ 103. „ 2 „ „ „ '(see Fig. 66)' *read* '(see Fig. 191.)'

„ 160. „ 5 from top. For '(§998)' *read* '(§§1023, 1025.)'

„ 179. „ 11 „ „ „ 'page 177' *read* 'page 174.'

„ 222. „ 14 from bottom. For 'Chap. XXVI.' *read* 'Chap. XXVII.'

„ 223. „ 12 from top. For '(104°F.)' *read* '(118°F.)'

„ 230. „ 4 „ „ „ '(Chap. XXVI.)' *read* '(Chap. XXVII.)'

„ 232. „ 2 from bottom „ „ „ „ „

„ 277. „ 6 from top. „ '(Chap. XXVI.)' *read* '(Chap. XXVII.)'

„ 383 §1064. For "Flourescence" *read* 'Fluorescence.'

INDEX.

[The references are to the numbered sections (§) of the book. A few only (indicated always by "p.," or "pp.") are to its pages.]